Canon

Service Manual

ENGLISH EDITION

CANON LENS

EF135mm1:2.8SF
EF300mm1:2.8L

EF135mm1:2.8SF

REF. NO. C21-7261

REPAIR INSTRUCTIONS

Canon SERVICE MANUAL

REPAIR INSTRUCTIONS

No. CY8-1223-113-300

Camera Technical Service Department, Canon Inc.

Date June 1, 1987

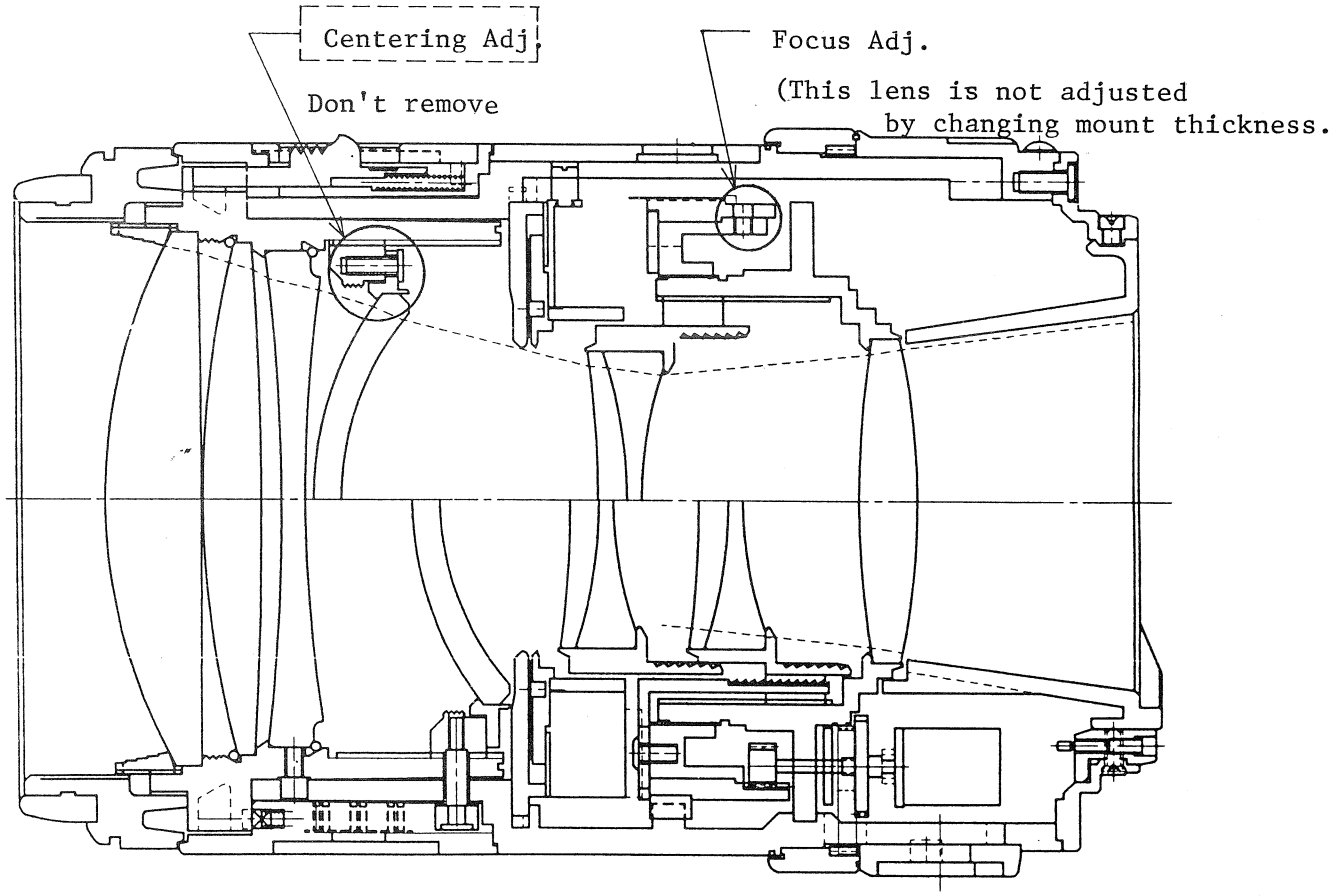
CANON LENS EF135mm 1:2.8 SF

Ref. No. C21-7261

Special Optical Adjustments:

Centering.	(Yes)	No
Tilt	Yes	(No)

Notice: Optical centering would be necessary if the Front Lens Unit (CY1-2242-000) were disassembled. The unit is stocked so the centering adjustment is not necessary.



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NOTICE: For general information about this lens, see sections I, II, III, and IV of the EF50mm f/1.8 repair guide.

EF135mm f/2.8 SF Lens Expendables List

-ADHESIVES-

Part Number	Name	Remarks	Plastic Safe?
CY4-9302-000	Double faced tape	Sheet #468 (200 x 300mm)	YES
CY9-8002-000	Bond G-103	General Purpose (where flexibility is important)	YES
CY9-8007-000	Aron Alpha	Instant Bond (Cyanoacrylate)	YES
CY9-8009-000	Arontite R	For staking screws	NO
CY9-8011-000	Screw-lock	For staking screws	YES
CY9-8076-000	Vinylole 2200	General Purpose (except high stress applications)	YES

- LUBRICANTS -

Part Number	Name	Remarks	Plastic Safe?
CY9-8042-000	GE-N9	Soft focus ring coupling	YES
CY9-8086-000	FF-10	Helicoid & cam (New)	YES
CY9-8087-000	Lozoid 6308/31-F	Manual focusing ring (New)	YES

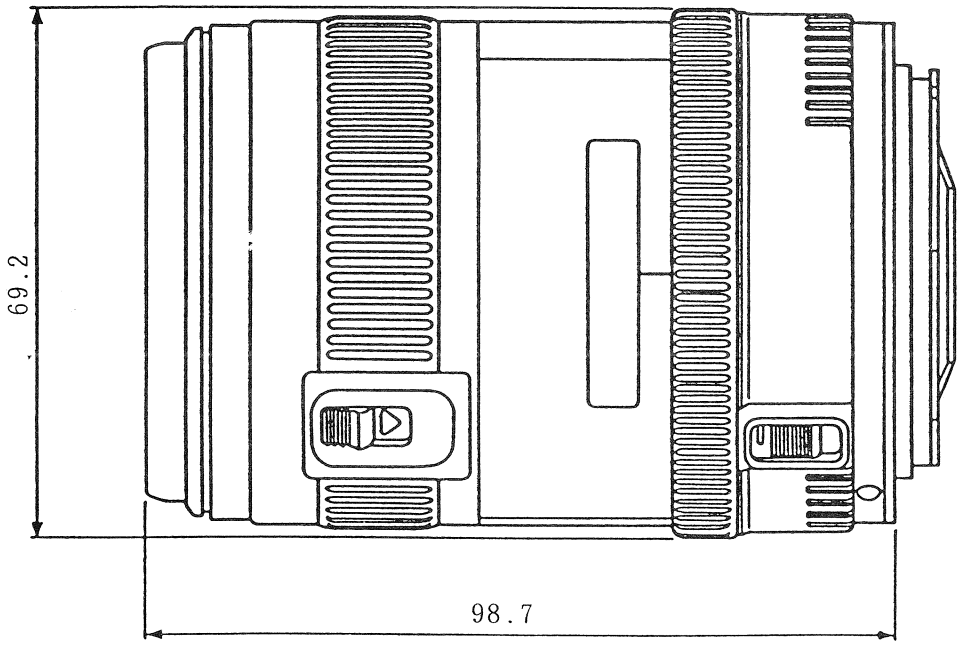
I. Specifications

The 135 mm focal length is very popular. There were three different 135mm lenses (f/2.0, f/2.8, and f/3.5) in the FD series. This lens fills this slot, and in addition has variable soft focus. In the normal position use it provides a clear, sharp image, while the soft focus settings provide a greater range of applications.

Features

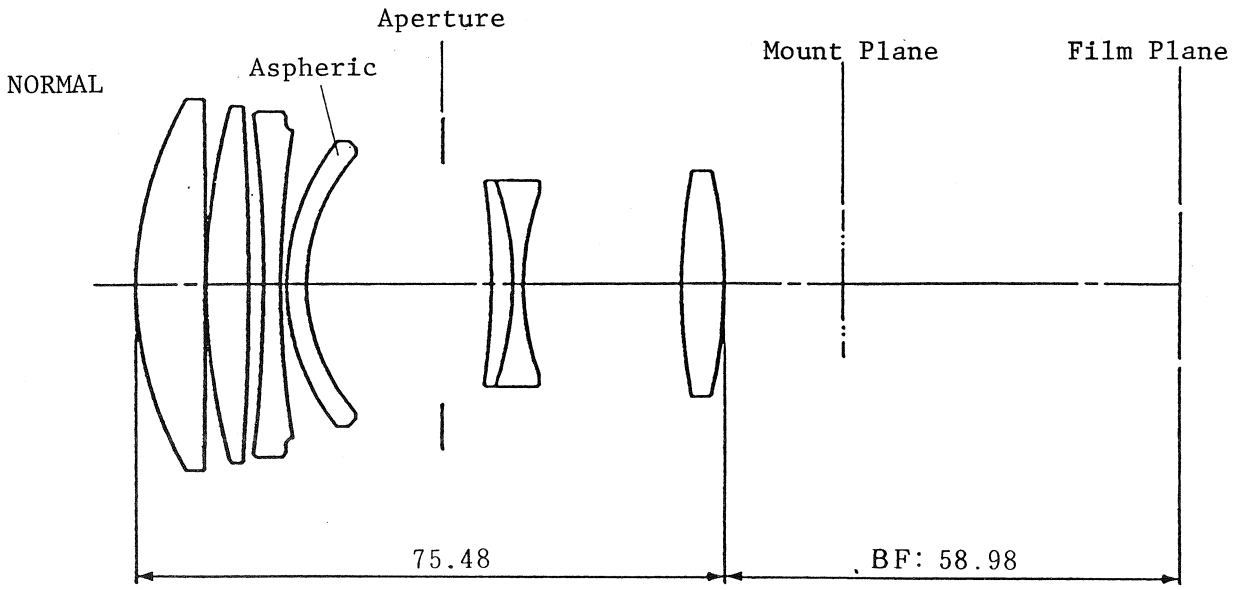
Variable soft focus by varying spherical aberration. Since spherical is aperture sensitive, blur can be varied both by the soft focus control ring and by the aperture. By using a molded glass aspherical lens as the moving element for soft focus, it is possible to achieve soft focus without the effect being distance sensitive.

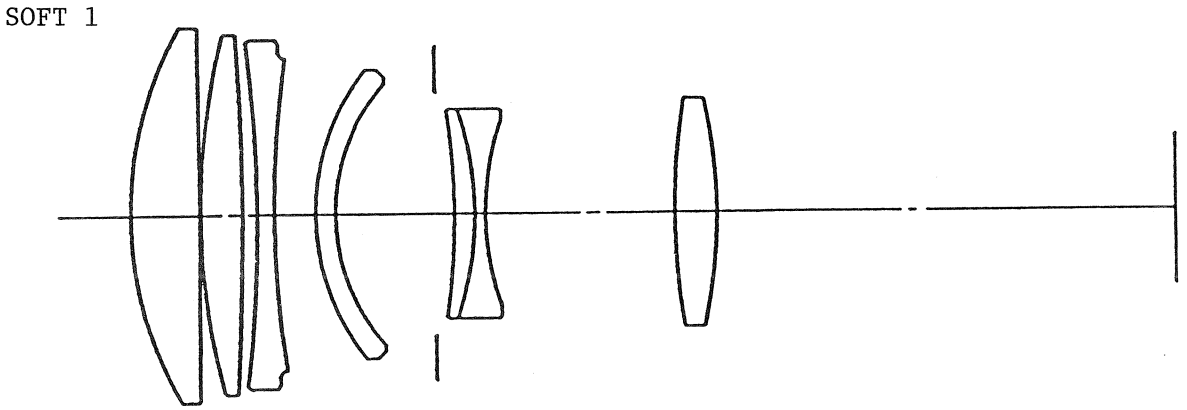
EF 135mm f/2.8 SF

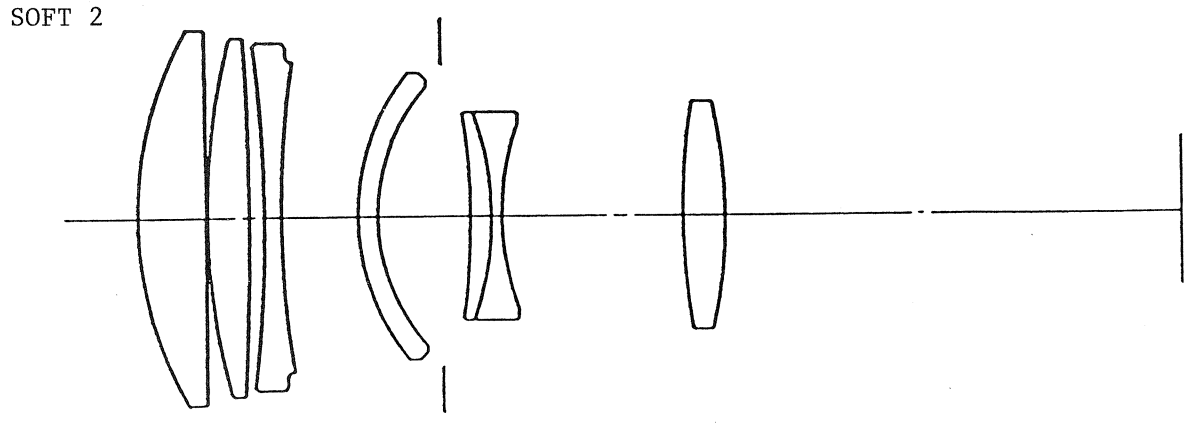


Unit: mm

Optical Schematic







1. Format: 24 x 36 mm

2. Focal length, aperture: 135mm, f/2.8

3. Optical structure: 5 groups, 5 elements;Super Spectra Coating

4. Angle of view (at infinity):

Diagonally (43.2 mm)	18°
Vertically (24 mm)	10°
Horizontally (36 mm)	15°

5. Autofocus (AF)

5-1 Drive system: AFD

5-2 Drive speed: 0.39 seconds (Actual operation between infinity and closest focus(1.3m), not including AF operation)

5-3 Manual: Mechanically clutched focusing ring

6. Focusing:

6-1 Extension system: Double helicoid

6-2 Range: 1.3m to infinity

6-3 Rotation angle, amount of extension

Condition	Rotationangle	Extension
1.3m to infinity	92° 6'	9.26mm
Infinity overrun	29°50'	2.95mm

6-4 Distance scale:

4.5 5.5 7 10 15 30 ∞ ft (fluorescent green)

1.3 1.6 2 3 5 10 m (gray)

6-5 Maximum magnification, field of view

Condition	Magnification (power)	Field of view (mm)
Close focus	0.13X	188 x 282mm

7. Soft Focus: Three step adjustment: Normal, Soft 1 and Soft 2

8. Mount

8-1 Type: New Canon mount

8-2 Signal transfer function: EOS system, with 5 signals as follows :

A) Lens condition
B) Lens type
C Photometry signal
D) Focal length
E) AF drive information

9. Aperture mechanism

9-1 Diaphragm control: Pulse control using EMD

9-2 Aperture range: f/2.8 - f/32

9-3 Number of diaphragm blades: 6

9-4 Depth-of-field scale: Provided

9-5 Infrared index: Provided

10. Filter thread: 52mm, 0.75mm pitch

11. Dimensions & weight: 69.2 mm diameter x 98.7 mm length / 410g

12. Related products

12-1 Hood: ET-65 (new)

12-2 Lens cap: E-52 (new)

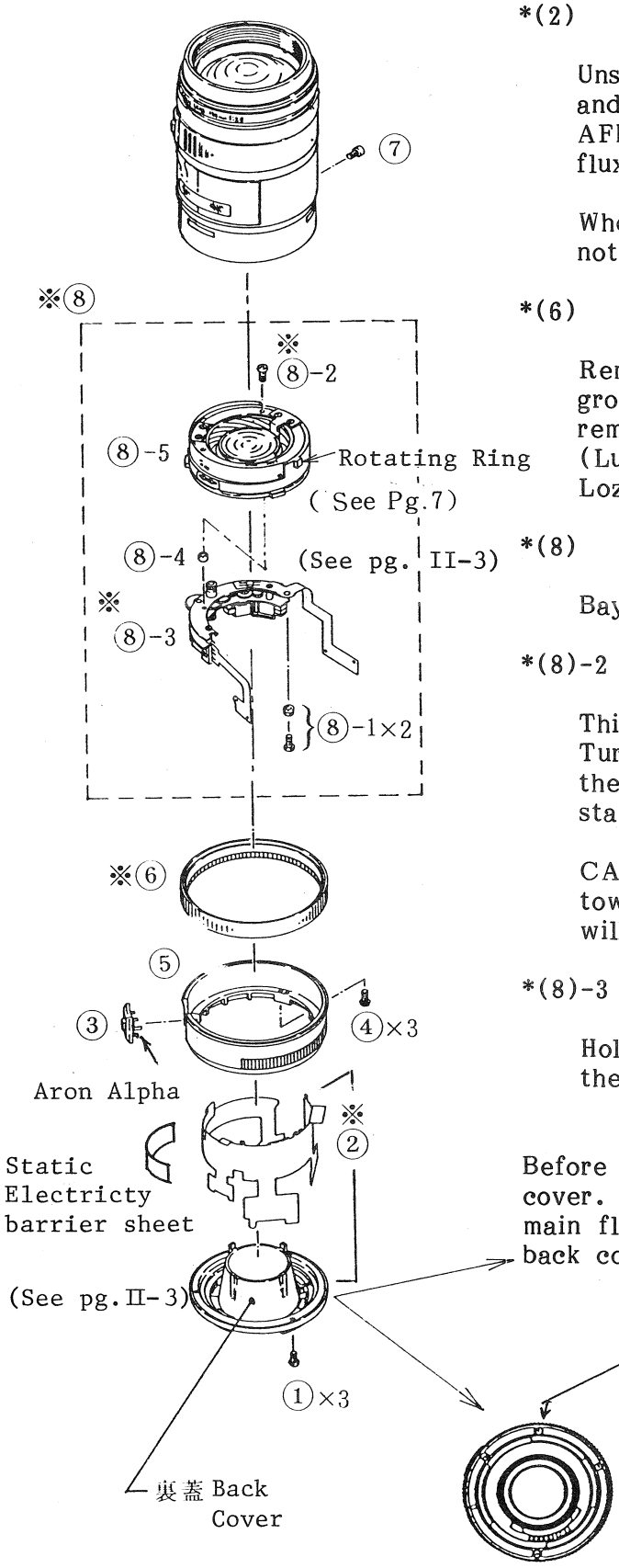
12-3 Lens case: LH-B15(hard) or ES-C13 (soft)

12-4 Dust cap: Common to all EF lenses (new)

13. Other: Maximum number of filters usable: 2

II. DISASSEMBLY & ASSEMBLY EF135mm f/2.8

1. AFD Unit Removal



*(2)

Unsolder the mount contacts, C, EMD, and AFD flex and the four leads from the AFD coil. Be careful with solder and flux splatter. (Ref: Wiring Diagram)

When replacing the main flex unit, do not forget the two jumper leads.

*(6)

Remove from inside. It has an assembly groove for this purpose, and can be removed by turning the manual ring. (Lube: Gear teeth and friction surfaces: Lozoid 6308/31-F)

*(8)

Bayoneted in place, turn left to remove.

*(8)-2 (See pg. 7 also)

This is the backlash adjustment screw. Turn the internal focusing ring to find the smoothest position and tighten and stake the screw.

CAUTION: If the ring is turned too far toward the close focus end, the helicoid will disengage.

*(8)-3

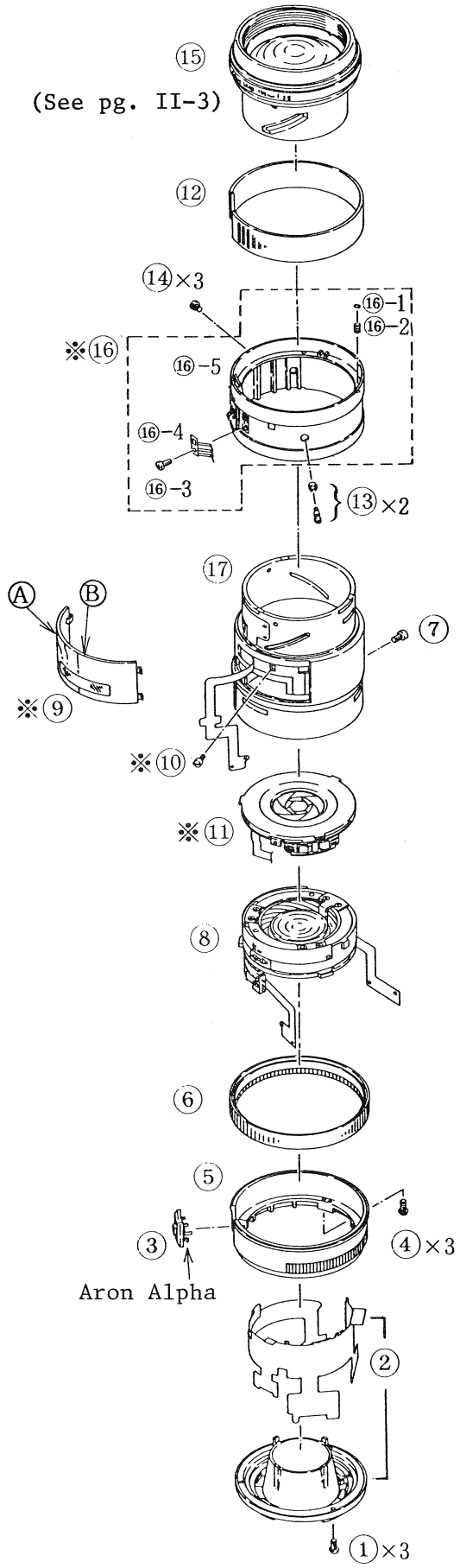
Hold (8)-3 toward the center and tighten the two screws (8)-1.

Before installing the mount, remove the back cover. Install the mount and position the main flex toward the outside and install the back cover.

Don't remove this screw.
(It is a hole filler.)

II. DISASSEMBLY & ASSEMBLY EF135mm f/2.8

2. EMD Unit Removal



*(16)

Be careful with the spring-loaded roller (16)-1, and the easily bent contact brush (16)-4. For best results, remove the contact brush first. (Lube: Friction surfaces between (17) and (15) - GE-N9)

*(9)

If (9) must be removed without first removing (12) through (16), place a wide, flat pryer into the left end (A) and press down and in to free the feet. Take care not to mar the external parts. If the forward parts have been removed, the panel can be removed easily prying from the upper edge (B).

The panel is held in place with double stick tape as well as the feet.

*(10)

Apply Arontite R to the threads.

*(11)

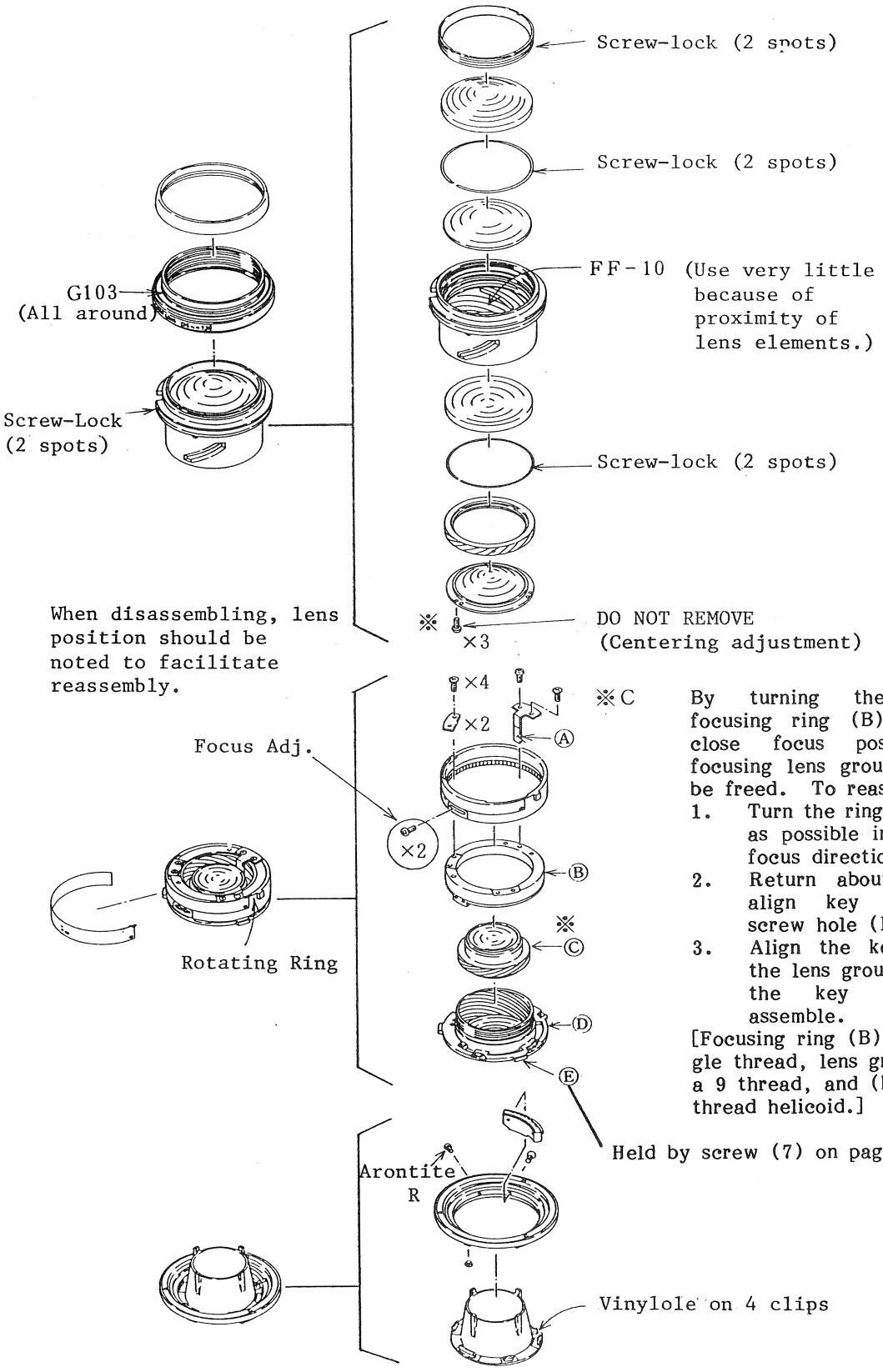
Bayonets in place - Use the screw heads as pin face screws to unlock the bayonet with a compass.

The AFD unit can be removed by removing (1) through (8).

The EMD unit can be removed without removing (12) through (16), but (9) is easier to remove without scarring if the forward parts are removed.

II. DISASSEMBLY & ASSEMBLY EF135mm f/2.8

2. Unit Disassembly (Front, Rear Lens; Mount Unit)



III. ADJUSTMENTS EF135/2.8SF

1. Focus Adjustment

Standard: ± 0.03mm

Use a known-good camera with a type B screen (split-image) and a magnifier. Check infinity focus on a collimator or with an actual target at least $100f^2$ distant.

Set the soft focus ring at normal.
Be careful of parallax when reading the distance scale against the index.

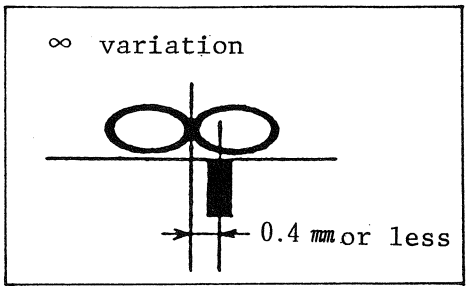


Fig. 1

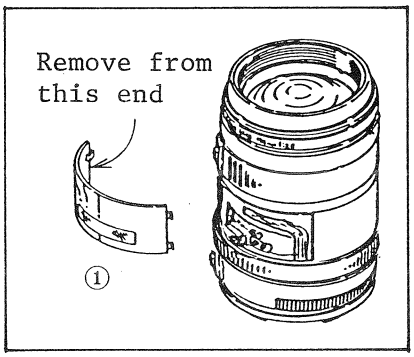


Fig. 2

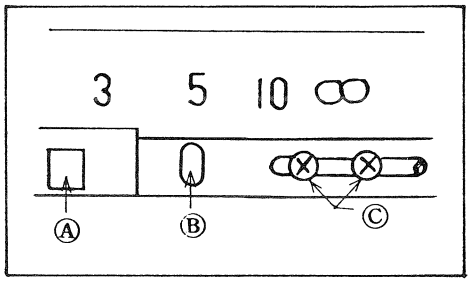


Fig. 3

Adjustment Method

1. Remove the focusing window panel (Ref: pg. 6).

2. Turn the manual ring so (A) and (B) in figure 3 are aligned and install a home-made pin to hold them in position for the adjustment.
(If the pin is made to fit the two holes snugly, the lens can be adjusted without installing the part containing the index each time to check the infinity position.

3. Loosen the focus screws (C) and adjust.

Table 1 : Resolution Chart

Image Height (mm)	0	4	8	12	16	20
S	100	100	63	40	40	40
Axial						
M		100	63	40	40	40

Checking resolution when adjusting focus is not necessary, but it is necessary if the rear lens of the front lens group is removed.

III. ADJUSTMENTS EF135mm f/2.8 SF

2. Pulse Adjustment

STANDARD: $0.9T \leq t \leq 1.1T$

Adjust if any of the three units shown at the right are changed. If not adjusted, AFD may work correctly at normal temperatures but fail at high or low temperatures.

Adjustment Method

1. Assemble the lens up to the point where the mount portion is attached to the rest of the lens.
2. Temporarily attach leads to the pads marked [PULS CH] and [D-GND] in figure 2.
3. Attach the lens mount to a camera body. Since the main part of the lens is hanging by the flex, be careful not to tear it.
4. Attach the leads (step 2) to the oscilloscope probe.
5. Set the lens in the AF mode and the camera in the ONE-SHOT mode, and press the shutter button. (The AF will search continuously because the lens is not in place.)
6. Adjust VR7 so the waveform is like figure 3 (C).

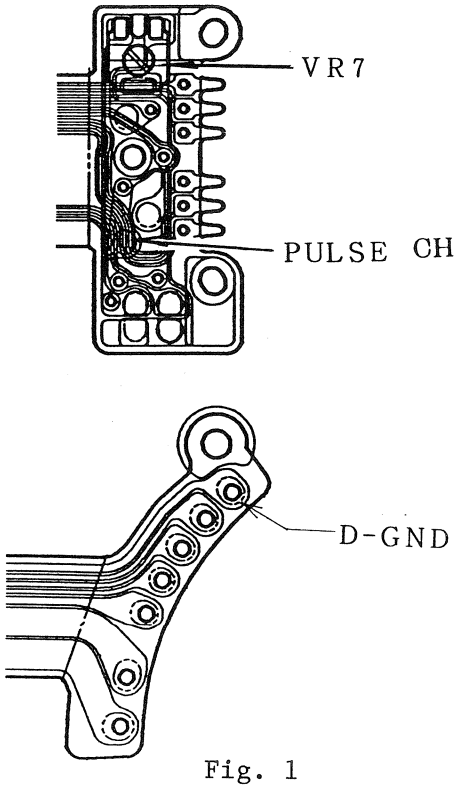
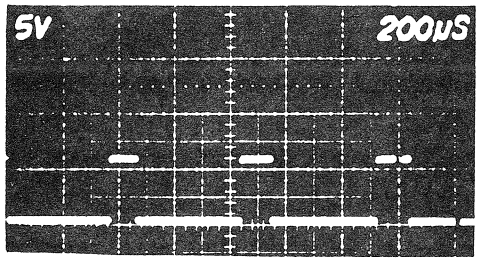
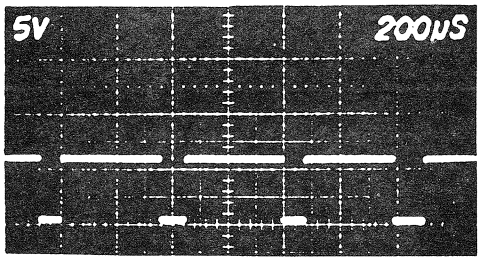


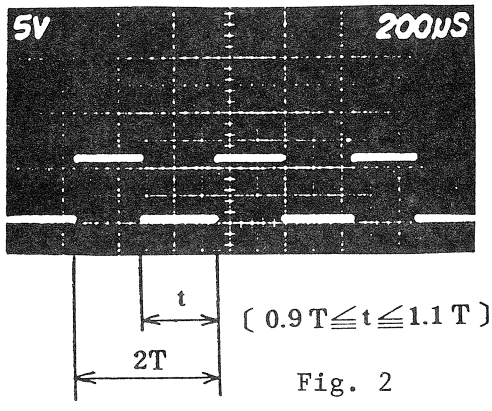
Fig. 1



(a) N.G Turn CCW



(b) N.G Turn CW



(c) O K

〔 $0.9T \leqq t \leqq 1.1T$ 〕

Fig. 2

VII. ADJUSTMENTS EF50mm f/1.8

3. "Best Focus Adjustment"Service Policy

STANDARD: $\pm \frac{1}{4}Fc$ Fig. = f/number
c = 0.035mm (Canon circle of confusion)

REF: AF Focus Point Limits: The difference in the best focus point and the actual point where the lens focuses must be within $\pm \frac{1}{4}Fc$.]

Some discrepancy between the focus point determined by the autofocus system and the actual best focus point of the interchangeable lenses is inevitable due to the inherent differences between the different lens types. The difference between the AF focus and the optical best focus for each lens type and is written into the lenses ROM so correction is made electronically.

There is also a difference between individual lenses which needs to be corrected, This correction is written into the lens' ROM with a expensive, special tool. This is called the "Best Focus Adjustment". This adjustment is too expensive to be a part of the service procedure. In its stead, the following actions will be taken.

Service Actions:

1. Main Flex Replacement
   Check the AF ADJ0 and AF ADJ1 pads on the flex being replaced and bridge the pads on the new flex in the same way.

2. FLU (CY1-2242) Replacement
   Open any bridges on the AF ADJ0 and AF ADJ1 pads.

3. Other Parts Replacement
   No action is required.

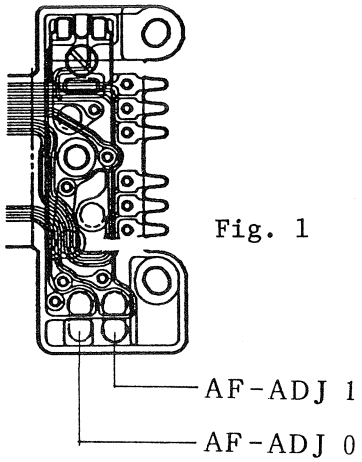
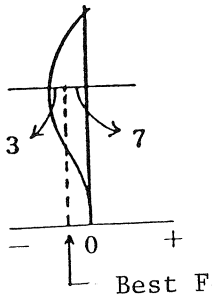


Fig. 1

Best Focus Correction (Reference)

Correction	AF ADJ0	AF ADJ1
$-\frac{3}{4}Fc$	Open	Closed
$-\frac{1}{4}Fc$	Closed	Closed
$+\frac{1}{4}Fc$	Open	Open
$+\frac{3}{4}Fc$	Closed	Open



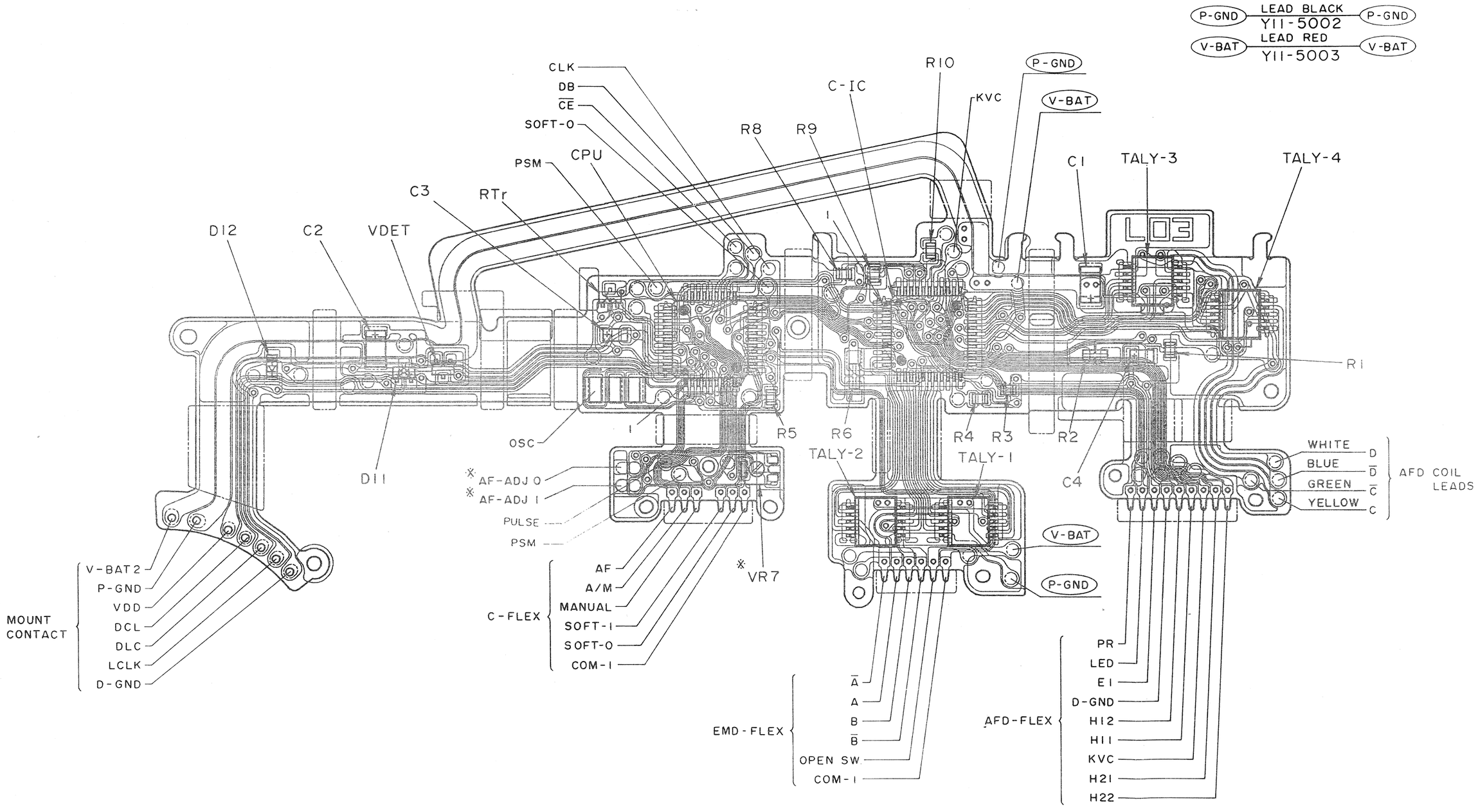
Correction varies with individual lens.

Correction set at 70% of maximum spherical aberration.

ELECTRIC DIAGRAM

CANON LENS EF 135 mm 1:2.8 SF

PCB DIAGRAM (MAIN FLEX)
CY8-1423-109-201



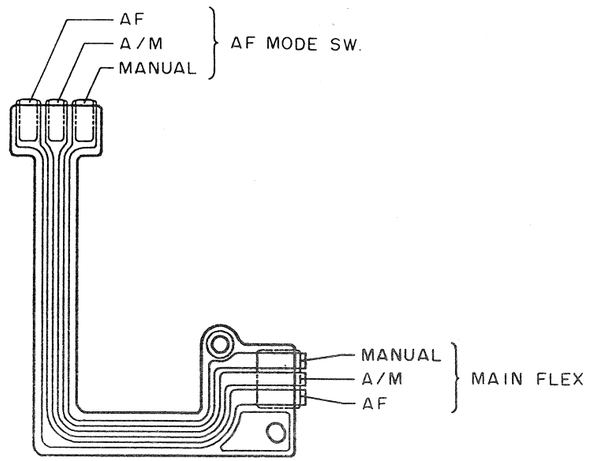
01 FEB, 1987

CANON LENS EF 135 mm 1:2.8 SF

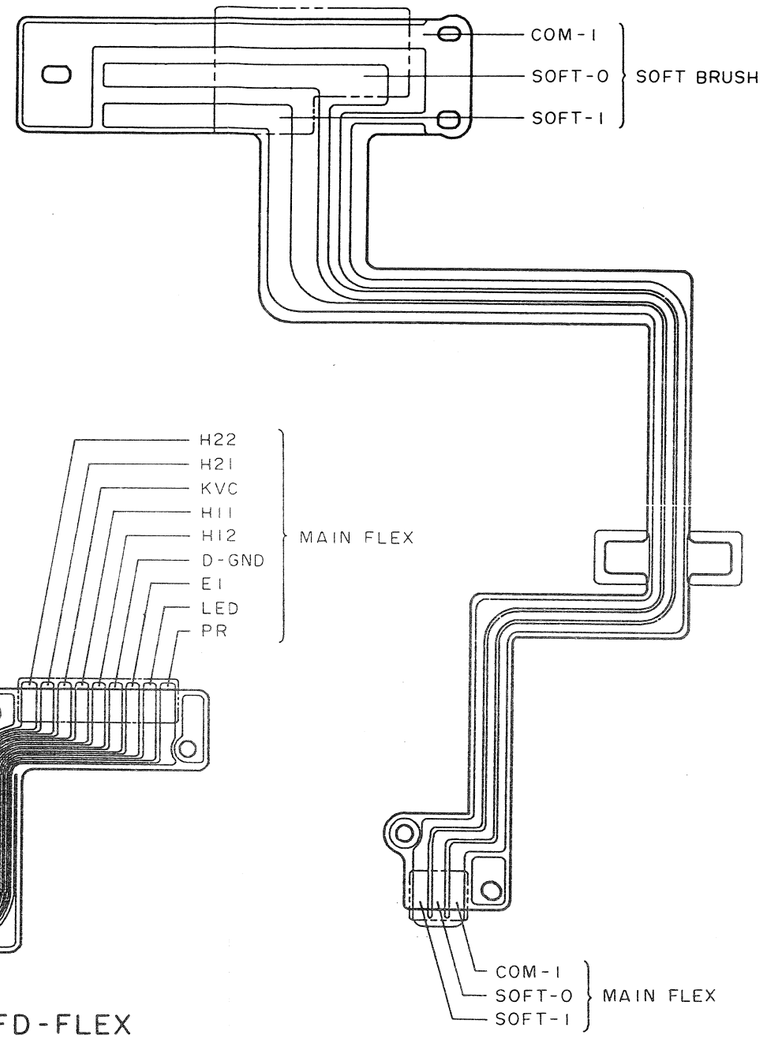
PCB DIAGRAM
CY8-1423-109-202

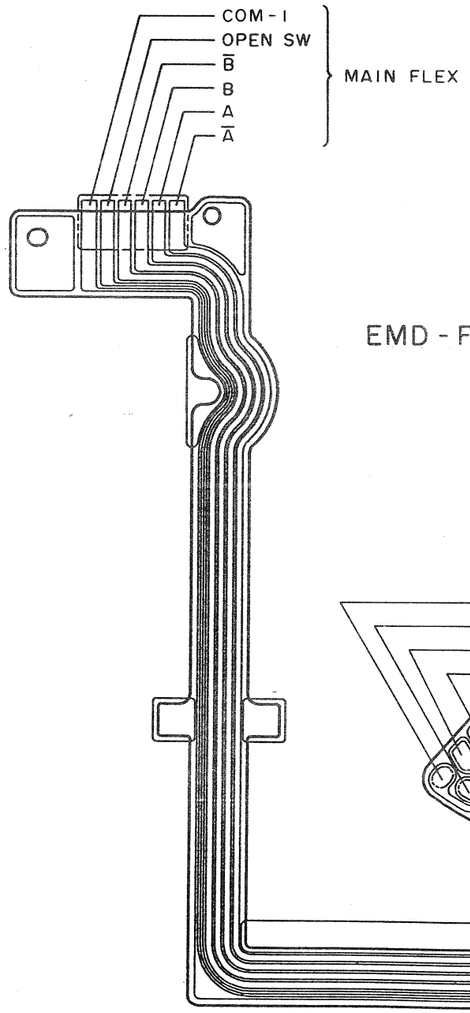
(C-FLEX, S-FLEX
AFD-FLEX, EMD-FLEX)

C-FLEX

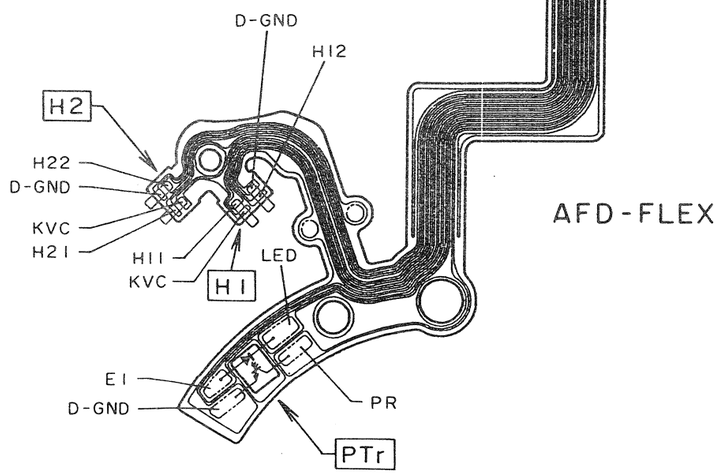


S-FLEX





EMD-FLEX

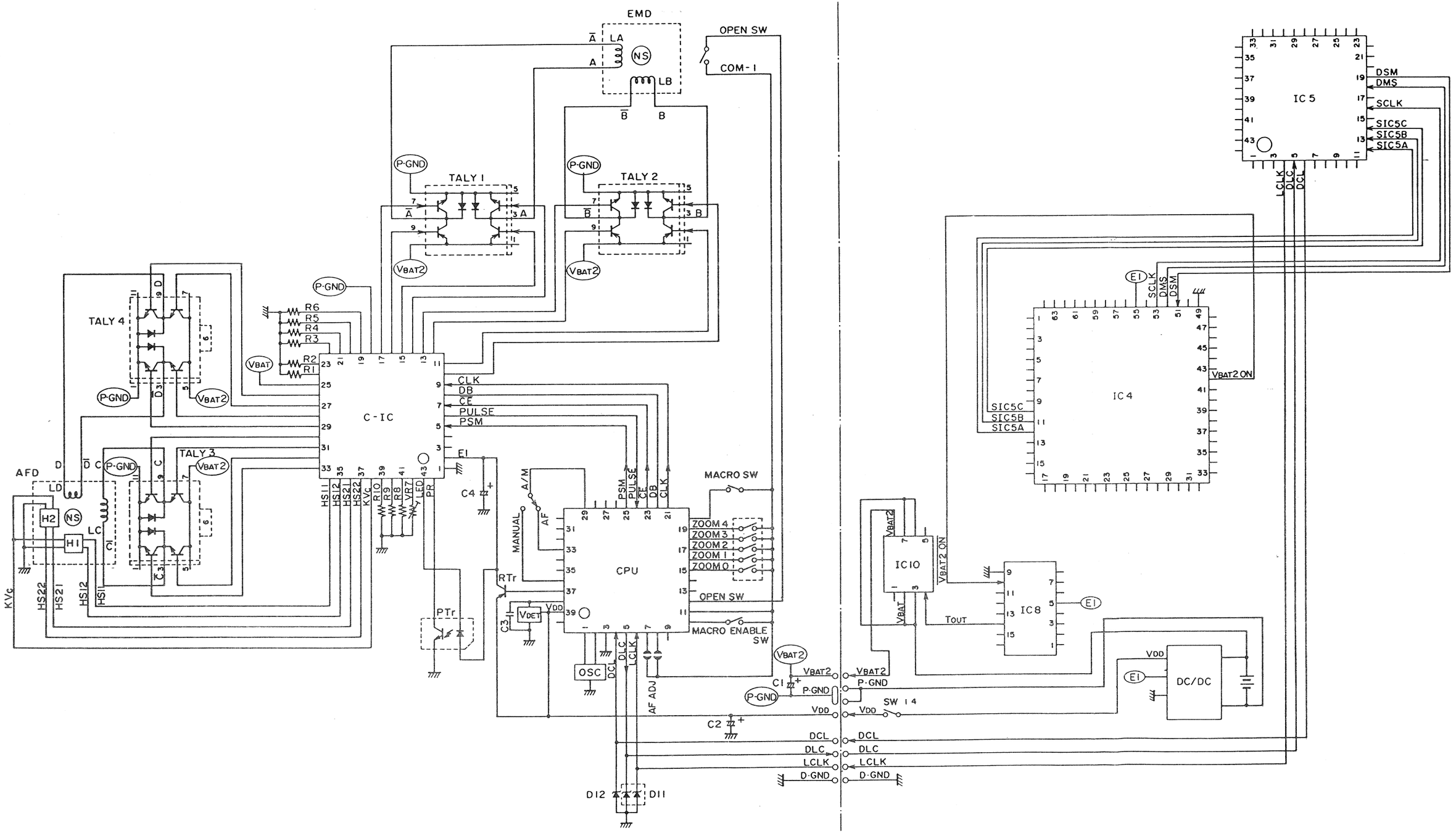


AFD-FLEX

01 FEB, 1987

CANON EF LENS

SCHEMATIC DIAGRAM
CY8-1623-101-200



01 JAN, 1987

EF300mm1:2.8L

REF. NO. C21-8252

REPAIR INSTRUCTIONS

Canon SERVICE MANUAL

REPAIR INSTRUCTIONS

No. CY8-1223-114-300

Camera Technical Service Department, Canon Inc.

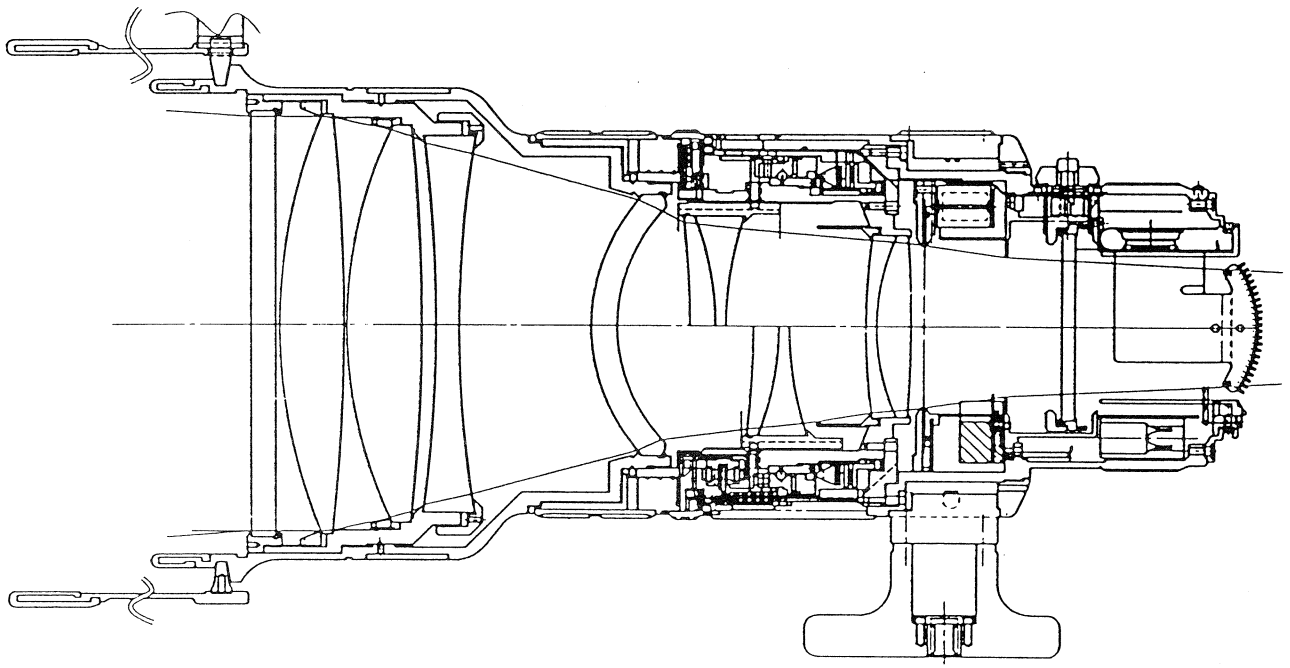
Date June 30, 1987

CANON LENS EF300mm 1:2.8L

Ref. No. C21-8252

Special Optical Adjustments:

Centering.	Yes	(No)
Tilt	Yes	(No)



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-ADHESIVES-

Part Number	Name	Remarks	Plastic Safe?
CY4-9302-000	Double faced tape	Sheet type #468 (20 x 30cm)	YES
CY9-8001-000	Pliobond		NO
CY9-8002-000	Bond G103	General purpose bond	NO
CY9-8009-000	Arontite R	For staking screws	NO
CY9-8011-000	Screw-lock	For staking screws	YES

- LUBRICANTS -

Part Number	Name	Remarks	Plastic Safe?
CY9-8044-000	GE-X8	Zoom Helicoid mix(metal OK)	YES
CY9-8045-000	GE-C4	Helicoid & cam (metal OK)	YES
CY9-8067-000	MoS_2 Grease	Tripod socket ring knob	NO
CY9-8086-000	FF-10	Helicoid & cam (NEW)	YES

- MISC. -

Part Number	Name	Remarks	Plastic Safe?
CY9-8090-000	NF-33	Moisture barrier	YES

I. EOS LENS Repair Precautions

1. FD lenses can be checked individually, but EOS lenses can only be checked as a part of the EOS system. In particular, diaphragm operation and autofocus operation can only be checked when combined with an EOS camera body.

2. A stepping motor is used in the diaphragm unit (EMD) and an ultrasonic motor (USM,) is used as the focusing drive. They can only be checked outside the assembled lens by wiring the units to the contacts in a lens mount and attaching the mount to a camera body. (Only operation, not accuracy, can be checked in this manner.)

3. The USM unit is not field serviceable. DO NOT disassemble it. It is stocked aas a unit only.

4. After the moisture proofing has been renewed, do not touch it. Fingerprints will reduce its effectiveness.

5. After repair, always clean the body contacts with Fronsolve.

6. No Service Manual will be issued for the Extender EF 2X. See the Parts Catalog for information concerning mount replacement.

II. USM (UltraSonic Motor)

The ultrasonic motor is a new type of ring-shaped motor that is driven by vibrations induced by ultrasonic waves, which is highly suited for use in AF drive systems.

1. Outline

Figure 1 outlines the ultrasonic motor (USM) used in EOS lenses. In this motor, ceramic piezoelectric elements with opposite polarities are glued to the ring that vibrates to drive the rotor by pressure contact. When alternating current at the resonant frequency is applied to the piezoelectric elements, the elements expand and contract according to polarity as shown in Fig. 2, generating a bending vibration. When the resonant frequency is then applied again after a 90o phase shift, a wave is generated in the bending vibration. This drives the rotor, which in turn moves a helicoid or cam to focus the lens.

Figure 3 shows the power control circuit of the USM. The resonant frequency generated by the oscillator is sent to two driver circuits, one of which contains a phase shifter to shift the resonant frequency 90°. Since high voltage is required to drive the USM, the circuit also includes a DC/DC converter to raise the power supply voltage from the camera for use by the USM driver circuit. This circuit controls the USM drive.

The following measures have been taken to increase the efficiency of the USM.

Resistance to the moving wave is reduced and wavelength increased by notching the body of the vibrator.

The rotor is made of lightweight aluminum to reduce power requirements.

The surfaces of the rotor and vibrator are treated with a special coating to raise the friction coefficient improving durability. This raises efficiency while allowing high torque.

Fig. 1

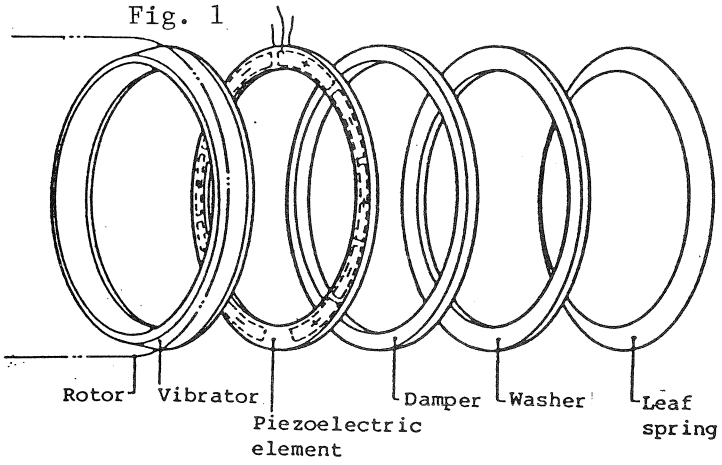


Fig. 2 Bending wave produced by the piezoelectric elements

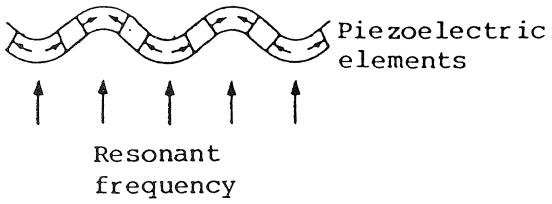
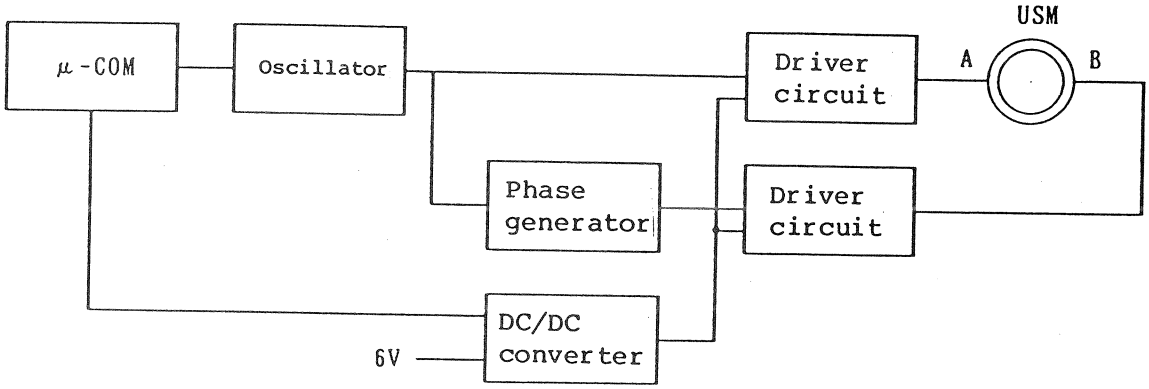


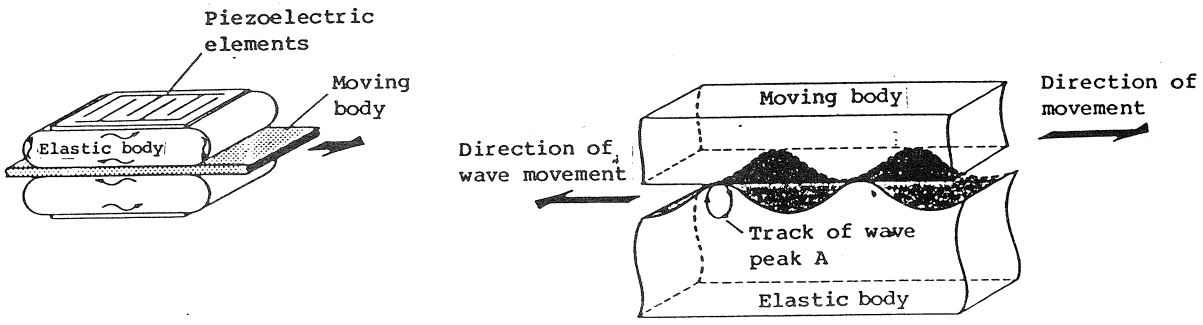
Fig. 3 USM power control circuit



2. Principle of operation

Figure 4 shows the principle of operation of the ultrasonic motor. When the piezoelectric elements vibrate, the vibrations travel along the surface of the elastic body. The figure on the right shows an enlargement of the surface of the elastic body at this time. In the figure, the point of contact between the vibrator and the moving body marked "A" traces an arc which, at its peak, moves in the opposite direction to the standing wave and at the same speed. As a result, the moving body is driven in the opposite direction from the standing wave by friction between the body and the vibrator. This can be understand by considering a "wave" formed by covering a pencil with a handkerchief. When the track made by wave peak A is regarded as the pencil, and the pencil is moved by pushing it with the finger, the perimeter of the pencil moves in the opposite direction to the wave; that is, rotation of the pencil corresponds to the track made by wave peak "A".

Fig. 4 **Operating principle of the ultrasonic motor**



3. Features

Ring shape enables electronic control without changing lenses from the conventional shape.

Allows design to be optimized to match the characteristics of individual lenses.

Highly efficient because the actuator can be located adjacent to the mechanism.

Low rotation speed and high torque makes a braking mechanism unnecessary.

Good start/stop response allows accurate control.

Generates almost no noise.

Simple configuration and compact.

4. Powered Manual Focusing

A unusual feature of lenses with USM is a type of power focusing using an electronic focusing ring. Built into the electronic ring is an encoder that detects the amount of ring rotation and outputs a signal to the lens microprocessor, which drives the USM. The encoder produces signals in direct proportion to the amount of ring rotation, allowing the USM to be driven by an amount which corresponds to the rotation angle of the electronic ring.

Table 1

Lens	Manual Focusing Mode
EF50mm f/1.0L	One speed only
EF28-80 f/2.8 - 4.0L	Speed varies automatically. The amount by which the USM is driven for a given amount of electronic ring rotation is greater at wide angle and less at telephoto, making the amount of rotation required to focus the image the same at both ends for easier operation. (The USM drive program which controls this determines the focal length from the signal output by the zoom recorder.)

Table 1(cont.)

EF300mm f/2.8L	Speed can be switched between three levels. Procedures are: Set the AF-M switch to M, then set the focusing ratio to 1/2, standard, or X2. Turn the electronic ring to focus the image. The amount of lens movement for a given amount of ring rotation in each of the three modes is as follows: (1) 1/2: Lens moves 1/2 the normal distance for a given angular displacement of the focusing ring. (2) Standard: The lens moves the same distance for a given angle as it does in the FD300/2.8L. (3) X2: The lens moves twice as far as in the standard mode.

III. Product Outline and Specifications

Objectives of Development

This lens carries over the optics of the FD 300 mm f/2.8L that is so widely acclaimed by professional photographers.

Features

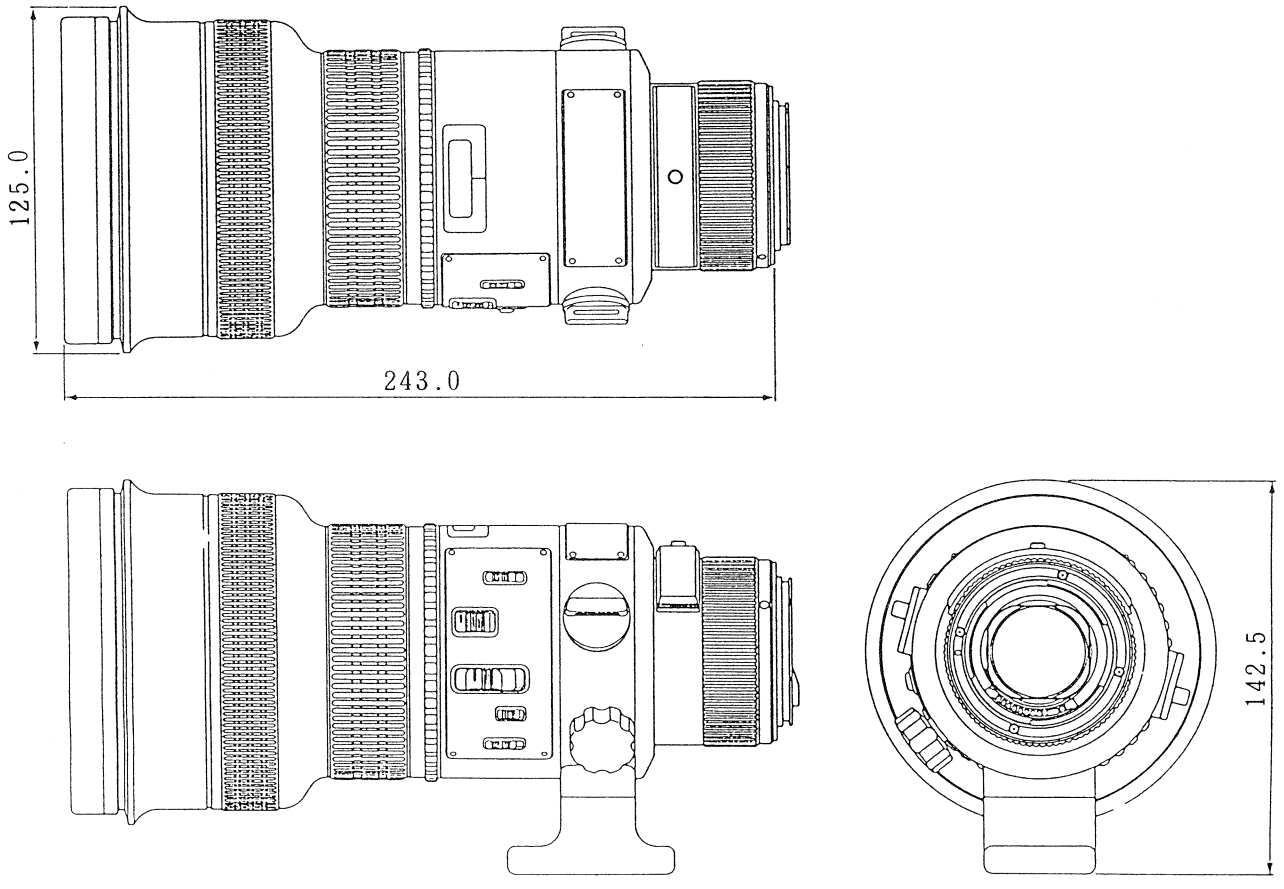
Large aperture and superior optics

Superior AF performance through the use of an ultrasonic motor for speed and quiet operation

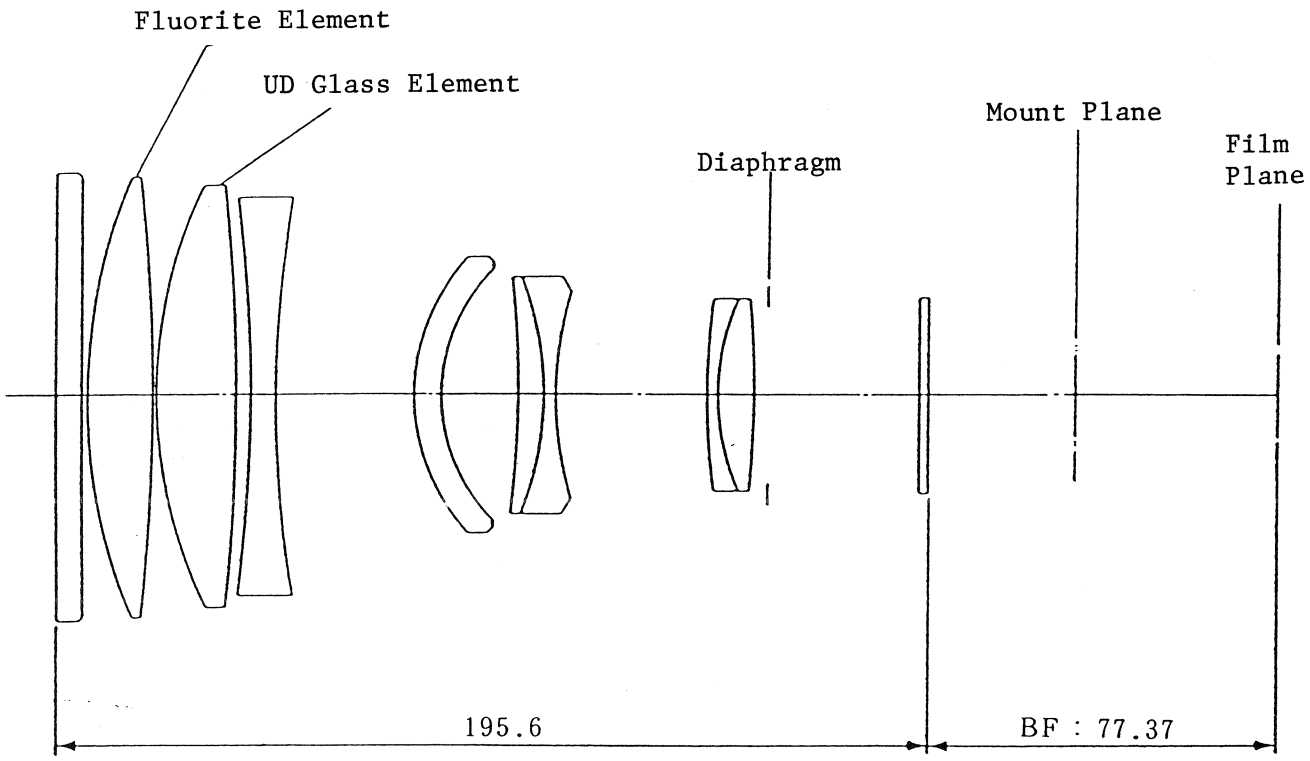
Focus preset function

Powered manual focusing uses an electronic focusing ring. Focusing speed can be switched between three speed.

EF300mm f/2.8L



Optical Schematic



SPECIFICATIONS

1. Format: 24 x 36 mm

2. Focal length/aperture: 300mm , f/2.8

3. Optical structure: 7 groups, 9 elements (Super Spectra Coating)
G-2: Fluorite, G-3: UD Glass

4. Angle of view (at infinity):

Diagonally (43.2 mm)	8° 15'
Vertically (24 mm)	4° 35'
Horizontally (36 mm)	6° 50'

5. Autofocus (AF)

5-1 Drive system: USM

5-2 Drive speed: 0.42 seconds (Actual operation between infinity and closest focus(3.0m), not including AF ranging)

5-3 Manual: Three speed powered manual focusing

6. Focusing:

6-1 Extension system: Double helicoid

6-2 Range: 3.0m to infinity

6-3 Rotation angle, amount of extension

Condition	Rotationangle	Extension
0.3m to infinity	84.67°	15.01mm
Infinity overrun	8.7°	None

6-4 Distance scale:

10 12 15 20 30 50 100 ft (fluorescent green)

3 4 5 7 10 15 30 m (gray)

6-5 Maximum magnification, field of view

Condition	Magnification (power)	Field of view (mm)
Close focus	0.11X	213 x 319mm

7. Mount

7-1 Type: New Canon mount

7-2 Signal transfer function: EOS system, with 5 signals as follows :

A) Lens condition
B) Lens type
C Photometry signal
D) Focal length
E) AF drive information

8. Aperture mechanism

8-1 Diaphragm control: Pulse control using EMD

8-2 Aperture range: f/2.8 - f/32

8-3 Number of diaphragm blades: 8

8-4 Depth-of-field scale: Provided

8-5 Infrared index: Provided

9. Filter: 48mm drop-in (at rear)

10. Dimensions & weight: 125.0 mm diameter x 243.0 mm length / 2.85kg

11. Related products

11-1 Hood: ET-118

11-2 Lens cap: Exclusive

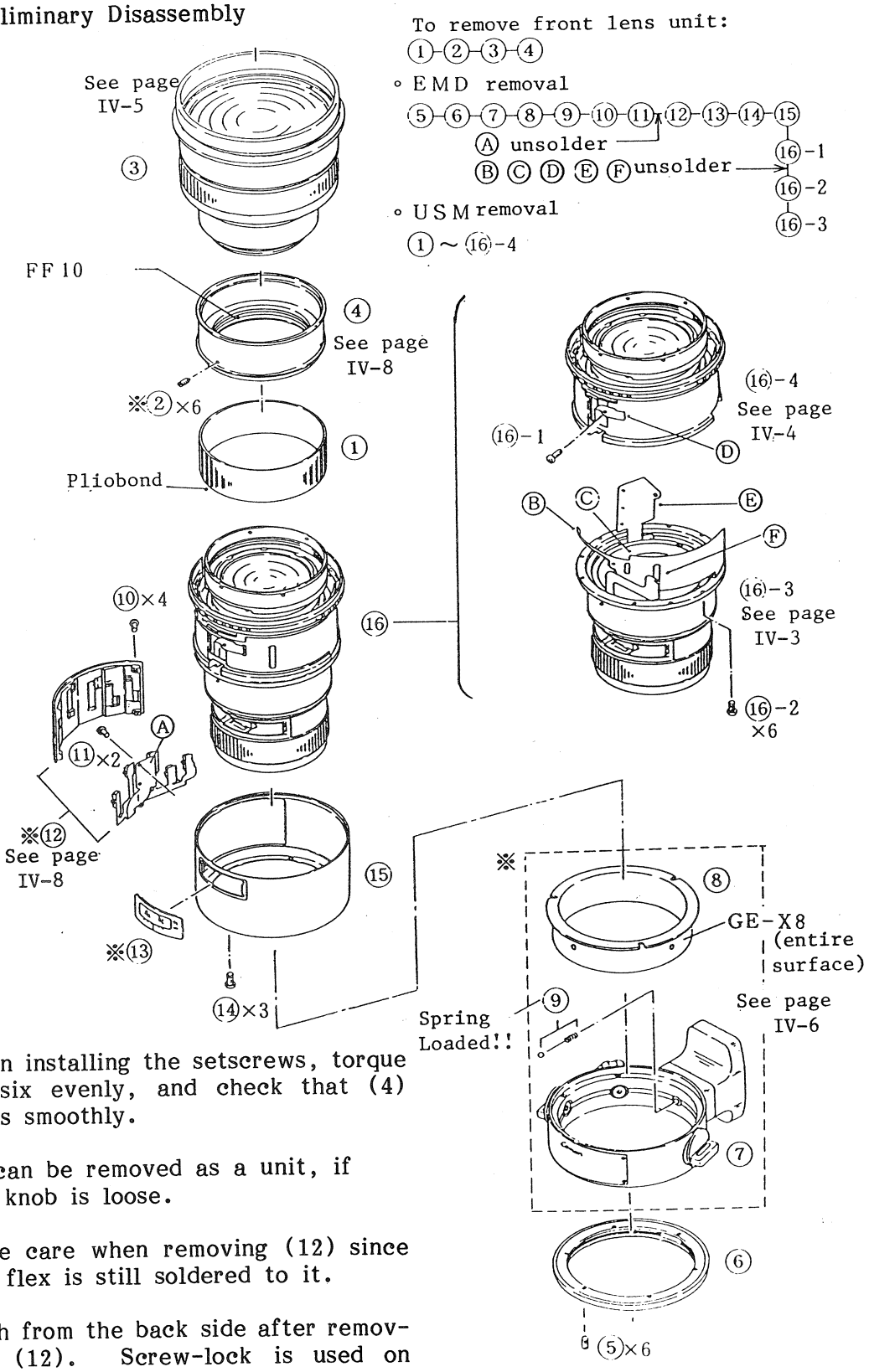
11-3 Lens case: E-137 (hard case)

11-4 Dust cap: Common to all EF lenses (new)

12. Other: Maximum number of filters usable: 1glass

IV. DISASSEMBLY & ASSEMBLY EF300mm f/2.8L

1. Preliminary Disassembly



*(2) When installing the setscrews, torque all six evenly, and check that (4) turns smoothly.

*(7,8,9) can be removed as a unit, if the knob is loose.

*(12) Take care when removing (12) since the flex is still soldered to it.

*(13) Push from the back side after removing (12). Screw-lock is used on clips (2 ea.).

IV. DISASSEMBLY & ASSEMBLY EF300mm f/2.8L

1. Preliminary Disassembly

---

1. Front Lens Unit Removal

1.1 When the index on (4) is set to one of the screw holes, three of the set-screws can be removed. After those three resistance removed, move the ring 60° and the remaining three setscrews can be removed.

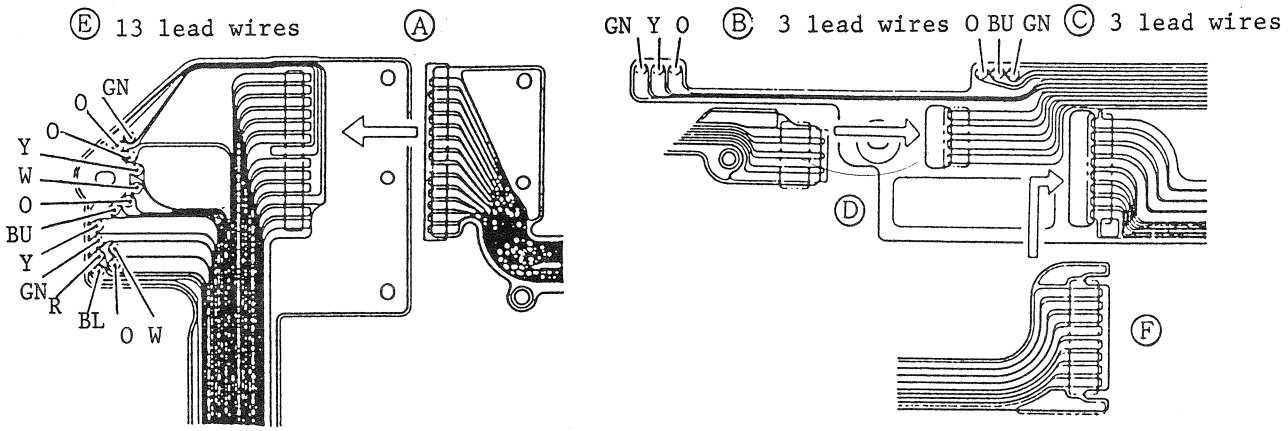
1.2 When reinstalling the screws, be sure to tighten them evenly. If they are improperly torqued, the ring will not turn smoothly.

2. Tripod Socket Ring (7) Installation

Install the inner click ring (8) into the tripod socket ring (7) so the click stop is engaged. Set the cutout in (8) at the bottom. Place the unit on the lens and screw the assembly collar (6) into place so the socket ring turns smoothly without excess play. Install the six setscrews (5).

Caution: When removing (8) be careful not to loose the ball and spring (9).

3. Unsolded (A) through (F).

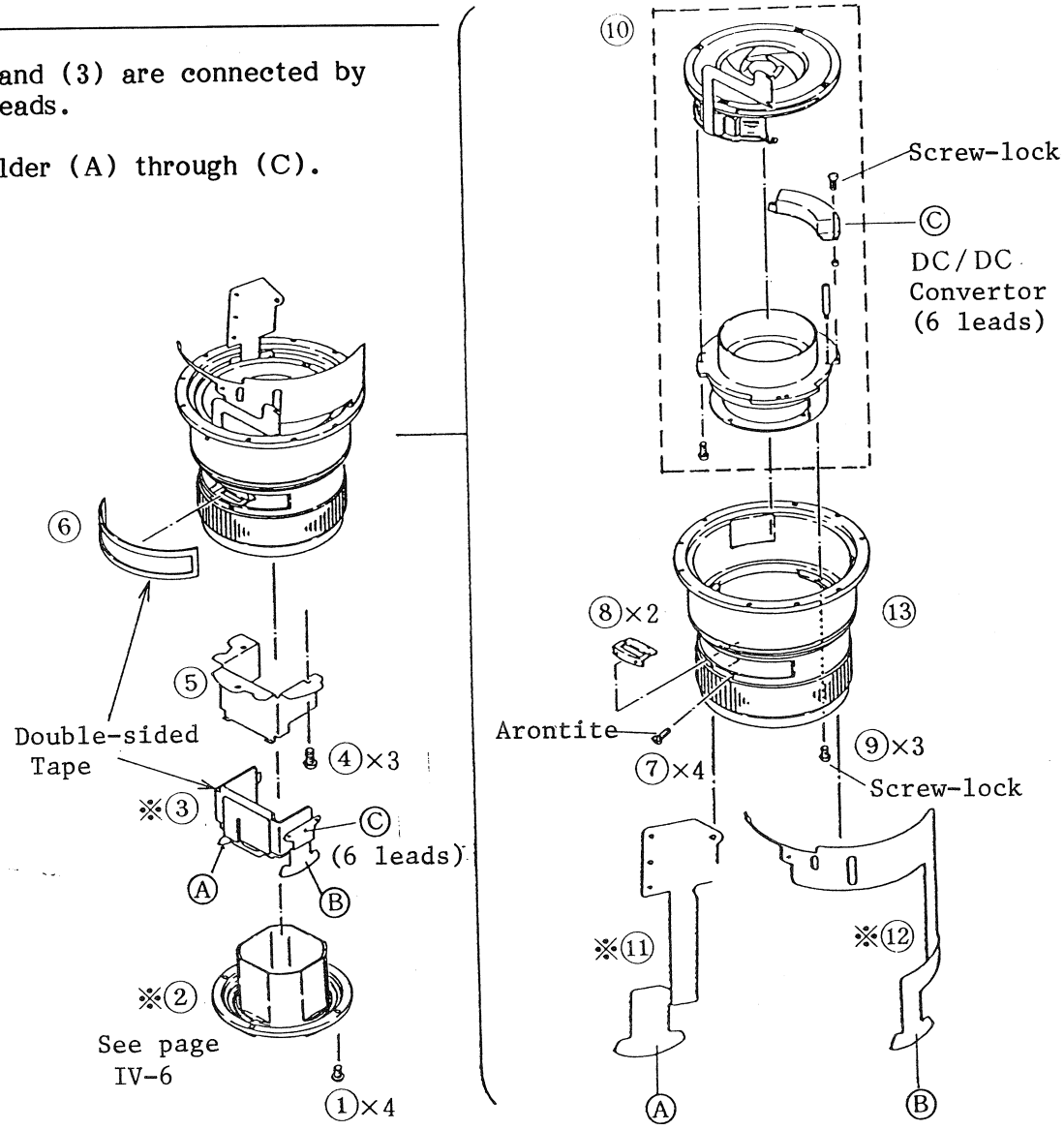


IV. DISASSEMBLY & ASSEMBLY EF300mm f/2.8L

2. EMD Unit Removal

*(2) (2) and (3) are connected by six leads.

*(3) Unsolder (A) through (C).



*(11) (12) EMD Unit (10) should be removed before trying to remove (11) and (12). There is not enough room to remove them safely unless (10) is removed.

EMD Removal Replacement

If EMD replacement is the only requirement, remove but do not unsolder the mount (2). Remove the three screws (4) and move (3) and (5) out of the way so screws (9) can be removed. After unsoldering at (C) then the unit (10) can be removed.

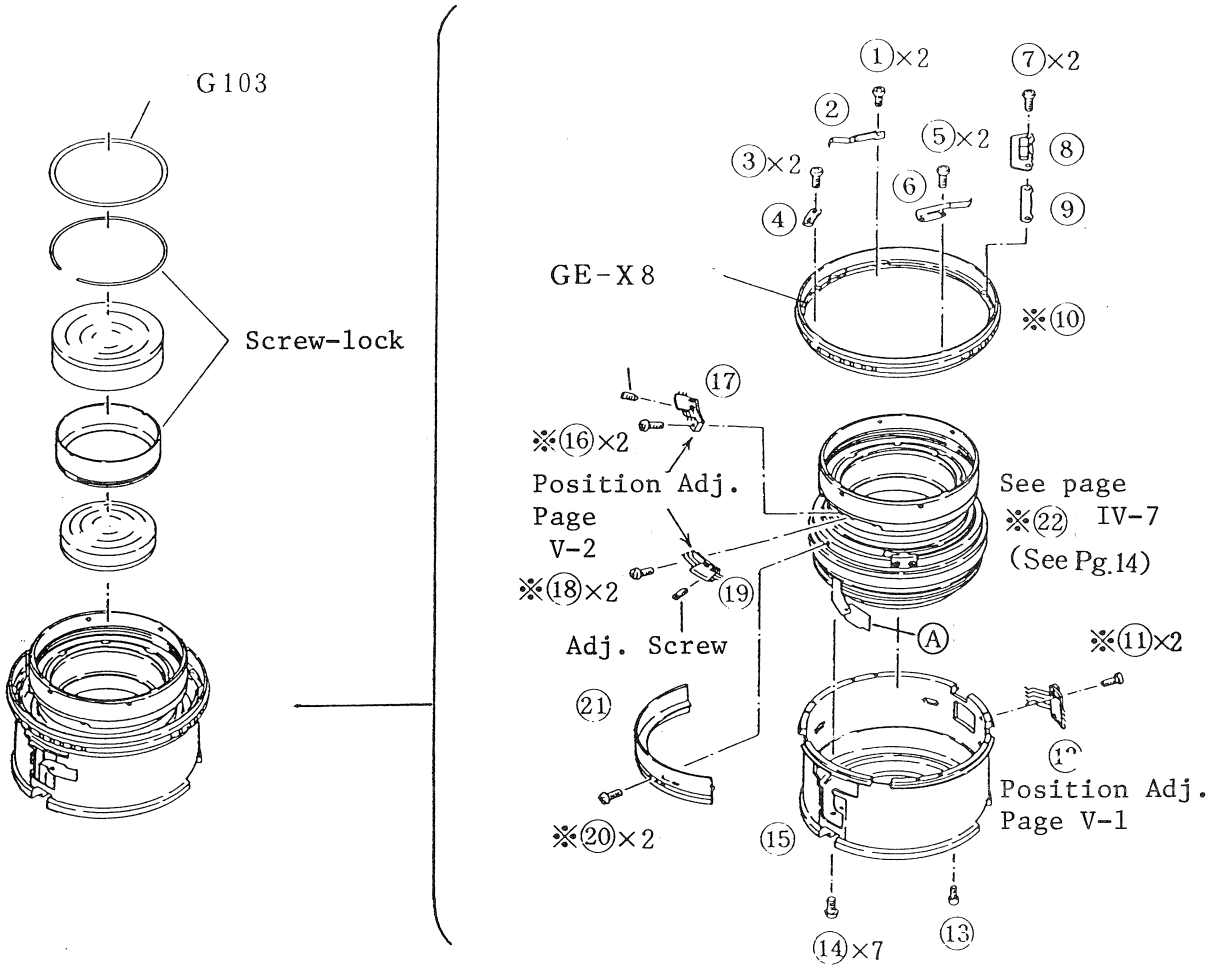
IV. DISASSEMBLY & ASSEMBLY EF300mm f/2.8L

3. USM Unit Removal

*(22) The USM Unit (22) is stocked only as a unit.

*(10) After replacing springs (2) and (6), rotate focus preset ring (10) against stopper (4) and let it go. It should return to the center position.

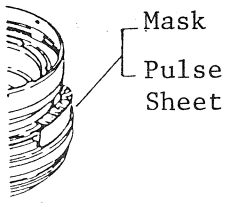
When (10) is rotated to either stop, the macro switch (8) should be on.



*(11)(16)(18) & (20): Stack with screw-lock after adjustment.

CAUTION: When the USM Unit is removed, do not touch the pulse sheet or mask. Adjustment of a order of precision impossible at the field level is required if they are disturbed.

Take care not to damage flex (A) when removing the USM.



IV. DISASSEMBLY & ASSEMBLY EF300mm f/2.8L

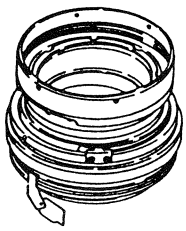
6. USM Unit Construction & Replacement Notes

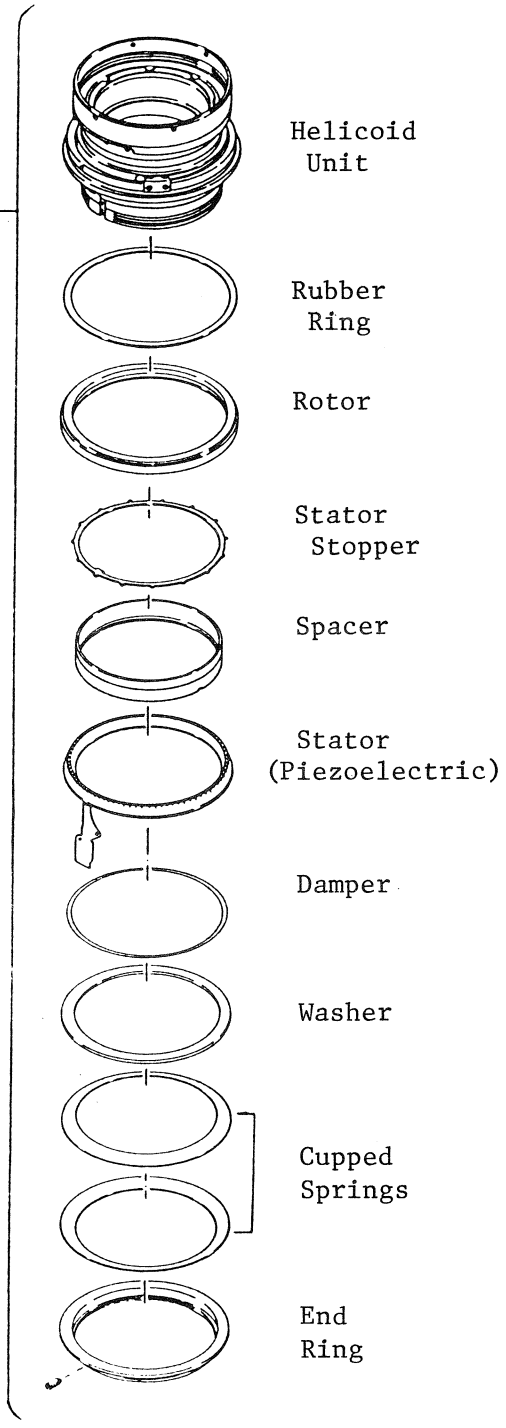
NOTICE: DO NOT DISASSEMBLE THE USM UNIT!! For Reference Only

1. USM Unit Replacement

When replacing the USM Unit, replace the DC/DC convertor also. The DC/DC convertor is stocked as a part of the USM unit.

The reason for this restriction is that when using manual focusing the speed of rotation of the focusing ring causes the power to switch between two voltages. Unless the DC/DC convertor is carefully matched to the USM, jerky focusing may occur. This is prevented by using the correct diodes on the DC/DC convertor.





2. Adjustments when USM is Replaced

Focus (Pg. V-1)
Manual Brush (Pg. V-2)
Pulse (Pg. V-4)

3. DC/DC Convertor Replacement
If the DC/DC Convertor is changed independently, remove the diodes from the previous convertor (which is matched to the USM) and install them in the new DC/DC convertor.

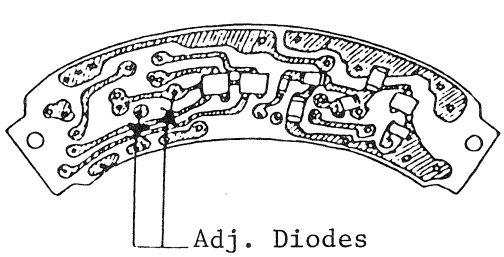
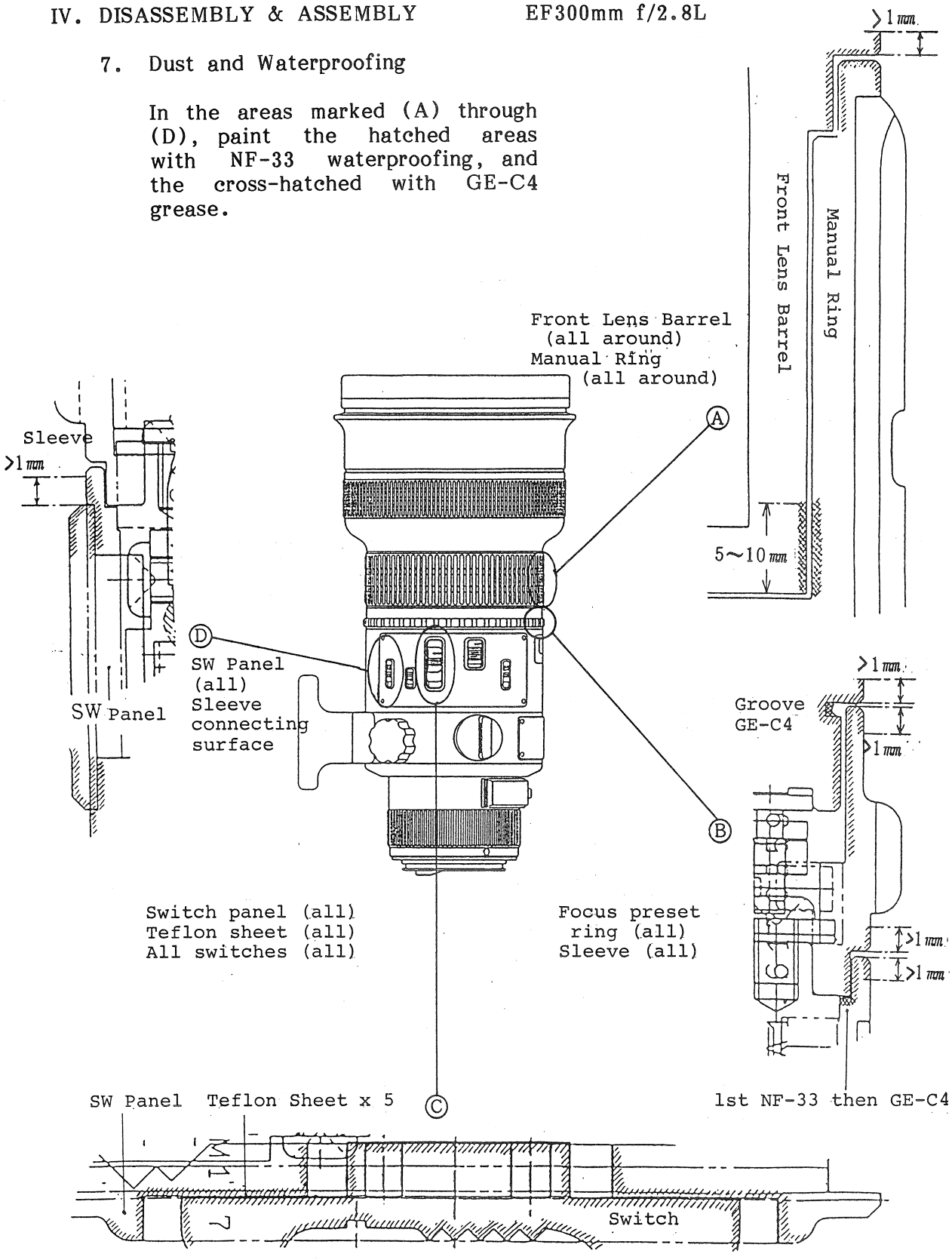


Fig. 1

IV. DISASSEMBLY & ASSEMBLY EF300mm f/2.8L

7. Dust and Waterproofing

In the areas marked (A) through (D), paint the hatched areas with NF-33 waterproofing, and the cross-hatched with GE-C4 grease.



V. Adjustments EF300mm f/2.8L

1. Focus Adjustment

1.1 Standard: ± 0.03mm

Use a known-good camera with a type B screen (split-image) and a magnifier. Check infinity focus on a collimator or with an actual target at least $100f^2$ distant.

During repair the focusing ring sleeve must be removed, and this lens has infinity overrun. Either scribe the infinity position before removing the sleeve, or make a 3.0 ±0.1mm stopper to locate the infinity position while the sleeve is removed.

2. Adjustment Method

Since this lens has infinity overrun for temperature compensation, both the actual infinity adjustment and the stopper position adjustment are necessary. [Ref.: pg. IV-3, remove (5) through (15)]

2.1 Infinity Adjustment

With the lens focused on an infinity target, loosen the two screws and align the angle of the "L" on the focusing scale with the index, as shown in figure 2. When completing the adjustment, stake the screw heads with screw-lock.

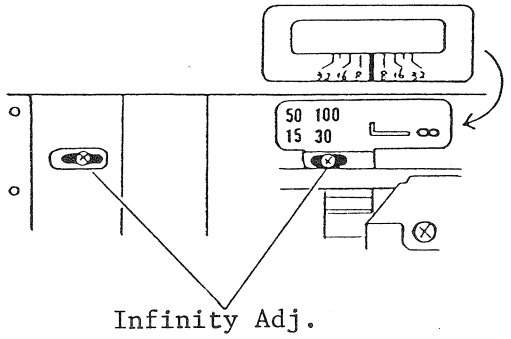


Fig. 1

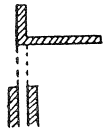


Fig. 2

2.2 Focus Stopper Adjustment (Electrical Stop Position)

With the lens set at infinity (Fig. 1), set the focus brush so the contacts fall within the width of the infinity mark. (After completing the adjustment, stake the screw heads with screw-lock.

Operate the lens in AF mode and check that it stops at the limits.

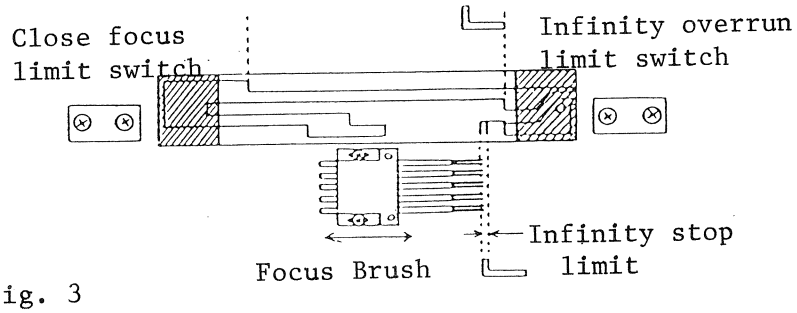


Fig. 3

V. Adjustments EF300mm f/2.8L

2. Manual Focus Brush Position Adjustment

Lenses with USM focusing use powered manual focusing which requires adjustments not necessary in lenses with AFD focusing. This adjustment is necessary if the manual brush is disturbed.

[If this adjustment is not correct, the helicoid may not follow the focusing ring. It may reverse or operate erratically. These problems may only be noticeable at low temperatures.]

Adjustment Method

1. Refer to page IV-1. Attach the lens as indicated by call-out (16) onto the camera.

2. Attach leads to SW8 (A) & (B), SW9 (A) & (B) and D-GND (Fig. 1).

3. Attach the leads from SW8 (A) & (B) and D-GND to the dual-trace oscilloscope.

4. Install the manual ring (4) and turn it slowly while monitoring the scope. Adjust screw [(1) (Fig. 3] to move the brush radially until the pulses are 180° out of phase. Disconnect the leads.

5. Attach the leads from SW9 (A) & (B) and D-GND to the dual-trace oscilloscope.

6. Turn the manual ring slowly while monitoring the scope. Adjust screw (2) (Fig. 3) until the pulses are 180° out of phase. Disconnect the leads.

7. Attach the leads from SW8 (A) & SW9 (A) and D-GND to the dual-trace oscilloscope.

8. Turn the manual ring slowly while monitoring the scope. Adjust SW8 or SW9 brush position tangently until the pulses are 90° out of phase.

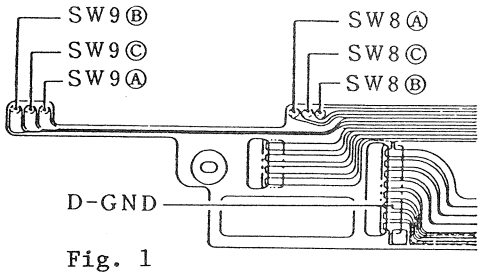


Fig. 1

LIMIT: 90° ± 45°

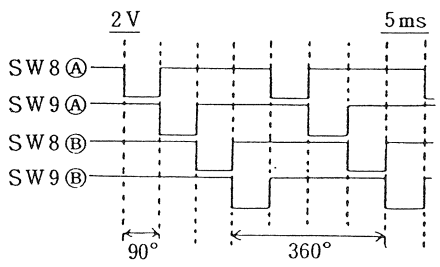


Fig. 2

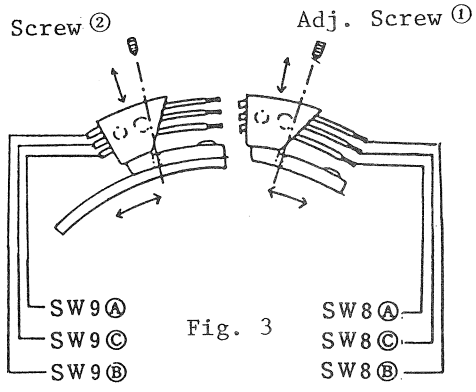


Fig. 3

V. Adjustments EF300mm f/2.8L

3. Maximum Aperture Limit Switch Adjustment

Lenses with AFD focusing use a mechanical limit switch for the EMD but lenses which use USM focusing use a phototransistor. The adjustment is made using the oscilloscope.

Adjustment Method

1. Assemble the lens entirely, except for the mount screws.
2. Attach leads to P-3 and D-GND (Fig. 1).
3. Attach the lens mount to the camera, taking care not to damage the flex.
4. Attach the leads from P-3 and D-GND to the oscilloscope.
5. Set the camera to AV or manual and set the diaphragm to minimum aperture.
6. Push the stop-down button while monitoring the scope. When the lens is stopped down, the signal should be "low" and "high" when the diaphragm is fully open. Adjust with VR3.

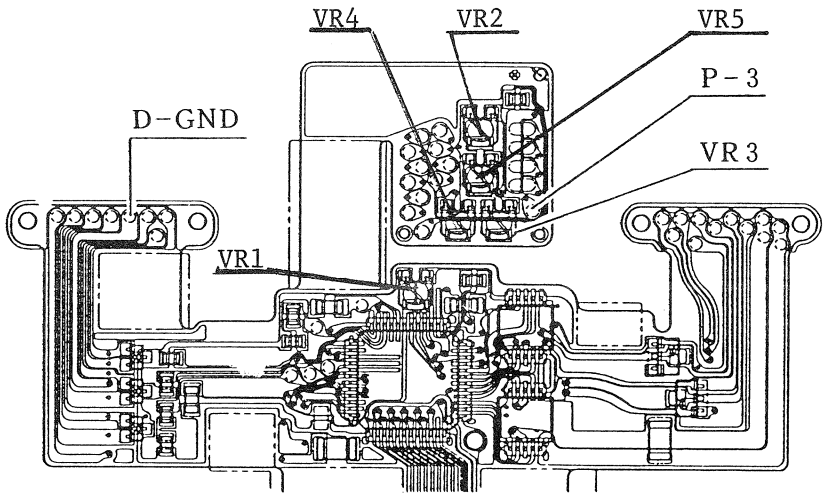


Fig. 1

NOTE: VR1 and VR2 are not adjustable by service personnel. VR1 is the inhibit voltage adjustment, and VR2 is the USM speed adjustment.

V. Adjustments EF300mm f/2.8L

4. Pulse Adjustment

STANDARD: $0.9T \leq t \leq 1.1T$

Adjust if main flex unit or USM unit is changed. If not adjusted, USM may work correctly at normal temperatures but fail at high or low temperatures. Pulse width is not pre-adjusted on spare parts main flex units.

Lenses with USM focusing use two photoreflectors instead of one as the AFD lenses do, therefore both must be adjusted.

Adjustment Method

1. Assemble the lens up to the point where the mount portion is attached to the rest of the lens only by the flex.
2. Attach leads to the P-1, P-2, and D-GND in figure 1.
3. Attach the lens mount to a camera body. Since the main part of the lens is hanging by the flex, be careful not to tear it.
4. Attach the leads P-1 and D-GND to the oscilloscope probe.
5. With lens in AF (3m to ∞ mode) and camera in ONE-SHOT mode, press the shutter button. (The AF will search continuously because the lens is not in place.)
6. Adjust VR4 so the waveform is like figure 2 (C).
7. Disconnect P-1 and connect P-2 and repeat the process, adjusting VR5.

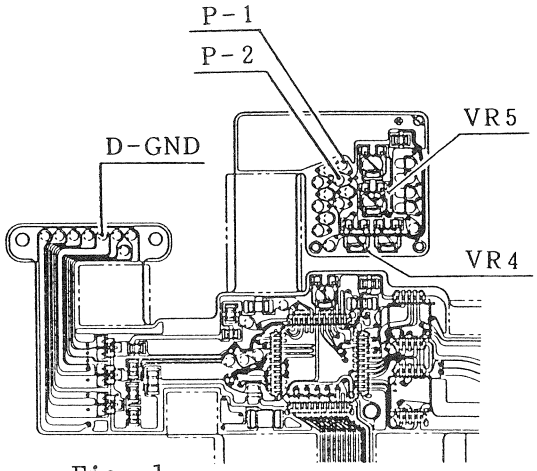


Fig. 1

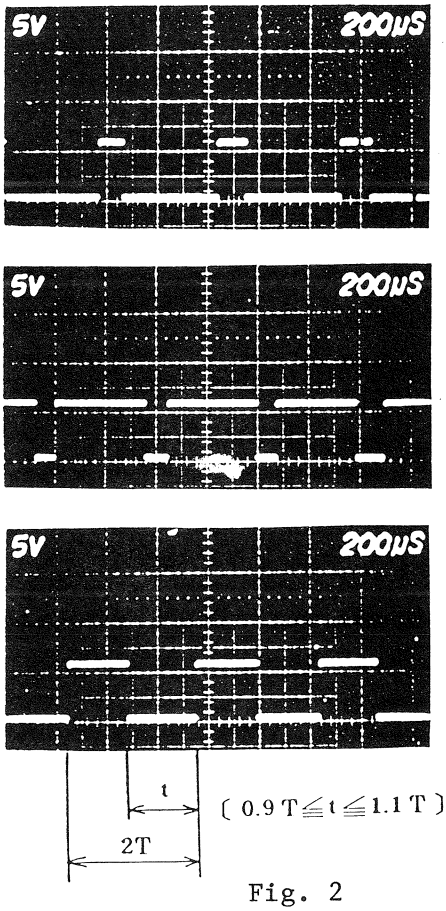


Fig. 2

V. Adjustments EF300mm f/2.8L

5. "Best Focus Adjustment" Service Policy

STANDARD: $\pm \frac{1}{4}Fc$ F = f/number
c = 0.035mm (Canon circle of confusion)

REF: AF Focus Point Limits: The difference in the best focus point and the actual point where the lens focuses must be within $\pm \frac{1}{4}Fc$.]

There is bound to be some discrepancy between the focus point determined by the autofocus system and the actual best focus point of the interchangeable lenses due to the inherent differences between the different lens types.

In the EOS system, the difference between the AF focus and the optical best focus has been determined for each lens type and the information written into the lenses Read Only Memory (ROM) so that correction for the difference at maximum aperture is made electronically.

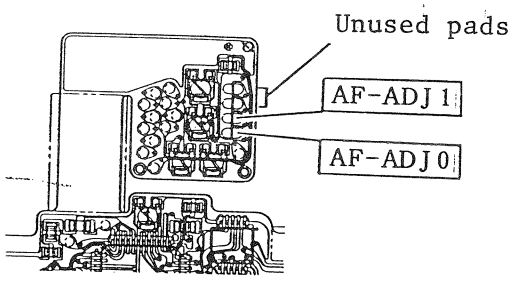
In actuality, in addition to this type difference, there is a difference between individual lenses within each type, which can be noticeable if not corrected, At the factory, correction is written into the individual lens' ROM with a expensive, special tool. This is called the "Best Focus Adjustment". Because of the tooling cost involved, this adjustment will not be a part of the service procedure. In its stead, the following actions will be taken.

Service Actions:

1. Main Flex Replacement
   Check the AF ADJ0 and AF ADJ1 pads on the flex being replaced and bridge the pads on the new flex in the same way.

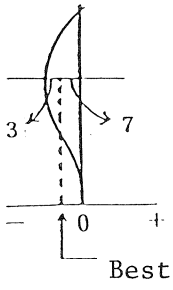
2. If lens G-2 (CN2-1003) is changed, open both pads.

3. If front defocus, use plus correction. If rear defocus, use negative.



Best Focus Correction (Reference)

Correction	AF ADJ0	AF ADJ1
$-\frac{3}{4}Fc$	Open	Closed
$-\frac{1}{4}Fc$	Closed	Closed
$+\frac{1}{4}Fc$	Open	Open
$+\frac{3}{4}Fc$	Closed	Open



Correction varies with individual lens.

Correction set at 70% of maximum spherical aberration.

VI. Electrical Circuit EF300mm f/2.8L

Symbol	MFG No. or Rating	Description
BZ		Beeper
C1	1uF T	Filter capacitor
C2	100pF C	Filter capacitor
C3	100pF C	Filter capacitor
C4	4.7uF T	Filter capacitor
C5	0.01uF T	Filter capacitor
C6	0.22uF T	Filter capacitor
C7	1500pF C	USM Drive
C8	3300pF C	USM Drive
C9	100pF C	USM Drive
C10	0.01uF C	USM Drive
C11	1uF T	Filter capacitor
C12	4.7uF T	Filter capacitor
EMD		Aperture Drive
IC1	MN17481	CPU
IC2	AN8339 F	Interface
IC3	UN206	EMD Drive
IC4	UN206	EMD Drive
IC5	MN15821	Voltage detector IC for CPU reset
L1	1.5mH	USM Drive
L2	1.5mH	USM Drive
OSC	C4CB	Oscillator
PTr1		Chopper wheel phototransistor
PTr2		Chopper wheel phototransistor
PTr3		Maximum aperture limit sensor
R1	10KOhm	USM Drive
R2	100KOhm	USM Drive
R3	8.2KOhm	USM Drive
R4	2.4KOhm	USM Drive
SW1		Manual focusing speed switch
SW2		Focus Switch
SW3		Focus Mode Switch
SW4		Beeper Switch
SW5		Focus Preset Switch
SW6		Recall Switch (Reading Switch in IB)
SW7		Range Limit Sensors
SW8		Manual Focusing Sensor
SW9		Manual Focusing Sensor
Tr1	UN-212Y	E1 power supply
USM		Focus drive
VR1	4KOhm	Inhibit voltage adj. (factory)
VR2	20KOhm	USM speed adj. (factory)
VR3	50KOhm	PTr3 adjustment
VR4	50KOhm	PTr1 adjustment
VR5	50KOhm	PTr2 adjustment

VI. Electrical Circuit EF300mm f/2.8L

Signal (Voltage)	Description
VBAT2	6V
PGND	0V
VDD	5.5V (CPU voltage supply)
DGND	0V
DCL	Data from camera to lens
DLC	Data from lens to camera
LCLK	Camera and lens clock pulse
CLK	IC-1 and IC-2 clock pulse
SIC2A	IC1 and IC2 communication
SIC2B	IC1 and IC2 communication
D0	IC1 Data
D1	IC1 Data
D2	IC1 Data
D3	IC1 Data
P1	Focusing drive pulse
P2	Focusing drive pulse
PSM	Aperture drive pulse
E1	5.5V
VB	DC/DC convertor output
DC0	DC/DC convertor control signal
DC1	DC/DC convertor control signal
EX0	Extender power sensor
EX1	Extender power sensor
A, $\overline{A}$	EMD coil A phase
B, $\overline{B}$	EMD coil B phase

VI. Electrical Circuit EF300mm f/2.8L

Notation: Components are listed by their symbol
IC pins or other terminations are enclosed in brackets [xx]
Signals are enclosed in parentheses (xx)

Step 1: Lens mounted on camera

	Camera Operations	Lens Operations
1.	When mount switch (SW14) closes, [VDD] (6V) is supplied to lens. IC3 senses than lens is mounted.	When VDD is applied, the [OSC] starts, IC1 is reset and checks the condition of all switches.
2.	IC3 sets E1ON to low, turning DC/DC convertor on.	
3.	The DC/DC convertor generates [E1] = 5V and [EM] = -5V .	
4.	When [E1] = 5V is applied to IC5, it sets [TRAP] to low.	
5.	When IC3 [TRAP] goes low, its [RES2] goes low resetting IC4, IC5, and IC6. At the same time the clock signal (f1) is sent to IC4 to drive it.	
6.	IC4 then sends clock signal (f2) to IC5 to drive it.	
7.	IC4 then sets [SIC3] to high to start serial communications with IC3 [system clock signal (SCLK) and IC4 data (DSM), and system clock signal (SCLK) and IC3 data data (DSM)].	
8.	IC4 sets [SIC5A] low, [SIC5B] low, and [SIC5A] high enabling communications with the lens.	
9.	IC5 communicates with the lens. lens clock signal (LCLK) and camera data (DLC), and lens clock signal (LCLK) and lens data (DLC) perform serial communications.	IC1 communicates with the camera serially. [Lens clock signal (LCLK) and camera data (DLC) and, lens clock signal (LCLK) and lens data (DLC).]

VI. Electrical Circuit EF300mm f/2.8L

Step 2. Focus Mode Switch Operated

Camera Operations	Lens Operations
1. When [DLC] goes low IC3 sets E1ON low turning DC/DC convertor on.	IC1 senses that focus mode switch (SW7) has switched and lens data (DLC) goes low.
2. The DC/DC convertor generates [E1] = 5V and [EM] = -5V .	
3. When [E1] = 5V is applied to IC5, it sets [TRAP] to low.	
4. When IC3 [TRAP] goes low, its [RES2] goes low resetting IC4, IC5, and IC6. At the same time the clock signal (f1) is sent to IC4 to drive it.	
5. IC4 then sends clock signal (f2) to IC5 to drive it.	
6. IC4 then sets [SIC3] to high to start serial communications with IC3 [system clock signal (SCLK) and IC4 data (DSM), and system clock signal (SCLK) and IC3 data data (DSM)].	
7. IC4 sets [SIC5A] low, [SIC5B] low, and [SIC5A] high enabling communications with the lens.	
8. IC5 communicates with the lens. lens clock signal (LCLK) and camera data (DLC), and lens clock signal (LCLK) and lens data (DLC) perform serial communications.	IC1 communicates with the camera serially. [Lens clock signal (LCLK) and camera data (DLC) and, lens clock signal (LCLK) and lens data (DLC).]

VI. Electrical Circuit EF300mm f/2.8L

Step 3. Focus Preset Switch Operated

	Camera Operations	Lens Operations
1.		IC1 senses that focus preset switch (SW5) has switched. At the same time it memorizes the focus setting as the "preset" focus. If the beeper switch (SW4) is on, it activates the beeper.

VI. Electrical Circuit EF300mm f/2.8L

Step 4. Recall Ring Operated

Camera Operations	Lens Operations
1. When [DLC] goes low IC3 sets E1ON low turning DC/DC convertor on.	IC1 senses that recall switch, SW10, has switched and lens data (DLC) goes low.
2. The DC/DC convertor generates [E1] = 5V and [EM] = -5V .	
3. When [E1] = 5V is applied to IC5, it sets [TRAP] to low.	
4. When IC3 [TRAP] goes low, its [RES2] goes low resetting IC4, IC5, and IC6. At the same time the clock signal (f1) is sent to IC4 to drive it.	
5. IC4 then sends clock signal (f2) to IC5 to drive it.	
6. IC4 then sets [SIC3] to high to start serial communications with IC3 [system clock signal (SCLK) and IC4 data (DSM), and system clock signal (SCLK) and IC3 data data (DSM)].	
7. IC4 sets [SIC5A] low, [SIC5B] low, and [SIC5A] high enabling communications with the lens.	
8. IC5 communicates with the lens. lens clock signal (LCLK) and camera data (DLC), and lens clock signal (LCLK) and lens data (DLC) perform serial communications.	IC1 communicates with the camera serially. [Lens clock signal (LCLK) and camera data (DLC) and, lens clock signal (LCLK) and lens data (DLC).]
9. IC4 sets [VBAT2ON] to low.	
10. IC8 sets [TOUT] to high.	
11. IC10 sets [VBAT2] = 6V and sends it to the lens.	

VI. Electrical Circuit EF300mm f/2.8L

Step 4. Recall Ring Operated(cont.)

	Camera Operations	Lens Operations
12.		IC1 turnsTr1 on and sends [E1] = 6V to IC2. IC2 instructs the USM to drive the focusing to the "preset" point. IC1 and IC2 communicate serially. [[SIC2A] = low, [SIC2B] = low, clock signal [CLK] and data (D0, D1, and D2)]
13.		IC2 turns DC/DC convertor on to drive the USM.
14.		As USM turns, Ptr1 and PTr2 put out a pulse signal.
15.		IC2 process the output of PTr1 and 2 and sends the pulses P1 and P2 to IC1.
16.		IC1 calculates the helicoid position using P1 and P2. When it reaches the 'preset" position, IC1 sends the USM stop signal to IC2. If beeper switch, SW4, is on, the beeper sounds.
17.		IC2 stops the USM.

VI. Electrical Circuit EF300mm f/2.8L

Step 5. Manual Focusing Ring Operated

Camera Operations	Lens Operations
1. When [DLC] goes low IC3 sets E1ON low turning DC/DC convertor on.	IC1 senses that manual focusing switches, SW8 & SW9, are switching, the position of the focusing speed switch, SW1, and computes the necessary helicoid movement. At the same time (DLC) goes low.
2. The DC/DC convertor generates [E1] = 5V and [EM] = -5V .	
3. When [E1] = 5V is applied to IC5, it sets [TRAP] to low.	
4. When IC3 [TRAP] goes low, its [RES2] goes low resetting IC4, IC5, and IC6. At the same time the clock signal (f1) is sent to IC4 to drive it.	
5. IC4 then sends clock signal (f2) to IC5 to drive it.	
6. IC4 then sets [SIC3] to high to start serial communications with IC3 [system clock signal (SCLK) and IC4 data (DSM), and system clock signal (SCLK) and IC3 data data (DSM)].	
7. IC4 sets [SIC5A] low, [SIC5B] low, and [SIC5A] high enabling communications with the lens.	
8. IC5 communicates with the lens. lens clock signal (LCLK) and camera data (DLC), and lens clock signal (LCLK) and lens data (DLC) perform serial communications.	IC1 communicates with the camera serially. [Lens clock signal (LCLK) and camera data (DLC) and, lens clock signal (LCLK) and lens data (DLC).]
9. IC4 sets [VBAT2ON] to low.	
10. IC8 sets [TOUT] to high.	
11. IC10 sets [VBAT2] = 6V and sends it to the lens.	

VI. Electrical Circuit EF300mm f/2.8L

Step 5. Manual Focusing Ring Operated(cont.)

	Camera Operations	Lens Operations
12.		IC1 turnsTr1 on and sends [E1] = 6V to IC2. IC2 instructs the USM to drive the focusing to the "preset" point. IC1 and IC2 communicate serially. [[SIC2A] = low, [SIC2B] = low, clock signal [CLK] and data (D0, D1, and D2)]
13.		IC2 turns DC/DC convertor on to drive the USM.
14.		As USM turns, Ptr1 and PTr2 put out a pulse signal.
15.		IC2 process the output of PTr1 and 2 and sends the pulses P1 and P2 to IC1.
16.		IC1 calculates the helicoid position using P1 and P2. When it reaches the 'preset" position, IC1 sends the USM stop signal to IC2. If beeper switch, SW4, is on, the beeper sounds.
17.		IC2 stops the USM.

VI. Electrical Circuit EF300mm f/2.8L

Step 6. Camera SW1 On

Camera Operations	Lens Operations
1. When SW1 goes low IC3 sets E1ON low turning DC/DC convertor on.	
2. The DC/DC convertor generates [E1] = 5V and [EM] = -5V .	
3. When [E1] = 5V is applied to IC5, it sets [TRAP] to low.	
4. When IC3 [TRAP] goes low, its [RES2] goes low resetting IC4, IC5, and IC6. At the same time the clock signal (f1) is sent to IC4 to drive it.	
5. IC4 then sends clock signal (f2) to IC5 to drive it.	
6. IC4 then sets [SIC3] to high to start serial communications with IC3 [system clock signal (SCLK) and IC4 data (DSM), and system clock signal (SCLK) and IC3 data data (DSM)].	
7. IC4 sets [SIC5A] low, [SIC5B] low, and [SIC5A] high enabling communications with the lens.	
8. IC5 communicates with the lens. lens clock signal (LCLK) and camera data (DLC), and lens clock signal (LCLK) and lens data (DLC) perform serial communications.	IC1 communicates with the camera serially. [Lens clock signal (LCLK) and camera data (DLC) and, lens clock signal (LCLK) and lens data (DLC).]
9. IC4 sets [VBAT2ON] to low.	
10. IC8 sets [TOUT] to high.	
11. IC10 sets [VBAT2] = 6V and sends it to the lens.	

VI. Electrical Circuit EF300mm f/2.8L

Step 6. Camera Sw1 On

	Camera Operations	Lens Operations
12.		IC1 turnsTr1 on and sends [E1] = 6V to IC2. IC2 instructs the USM to drive the focusing to the "preset" point. IC1 and IC2 communicate serially. [[SIC2A] = low, [SIC2B] = low, clock signal [CLK] and data (D0, D1, and D2)]
13.		IC2 turns DC/DC convertor on to drive the USM.
14.		As USM turns, Ptr1 and PTr2 put out a pulse signal.
15.		IC2 process the output of PTr1 and 2 and sends the pulses P1 and P2 to IC1.
16.		IC1 calculates the helicoid position using P1 and P2. When it reaches the 'preset" position, IC1 sends the USM stop signal to IC2. If beeper switch, SW4, is on, the beeper sounds.
17.		IC2 stops the USM.

VI. Electrical Circuit EF300mm f/2.8L

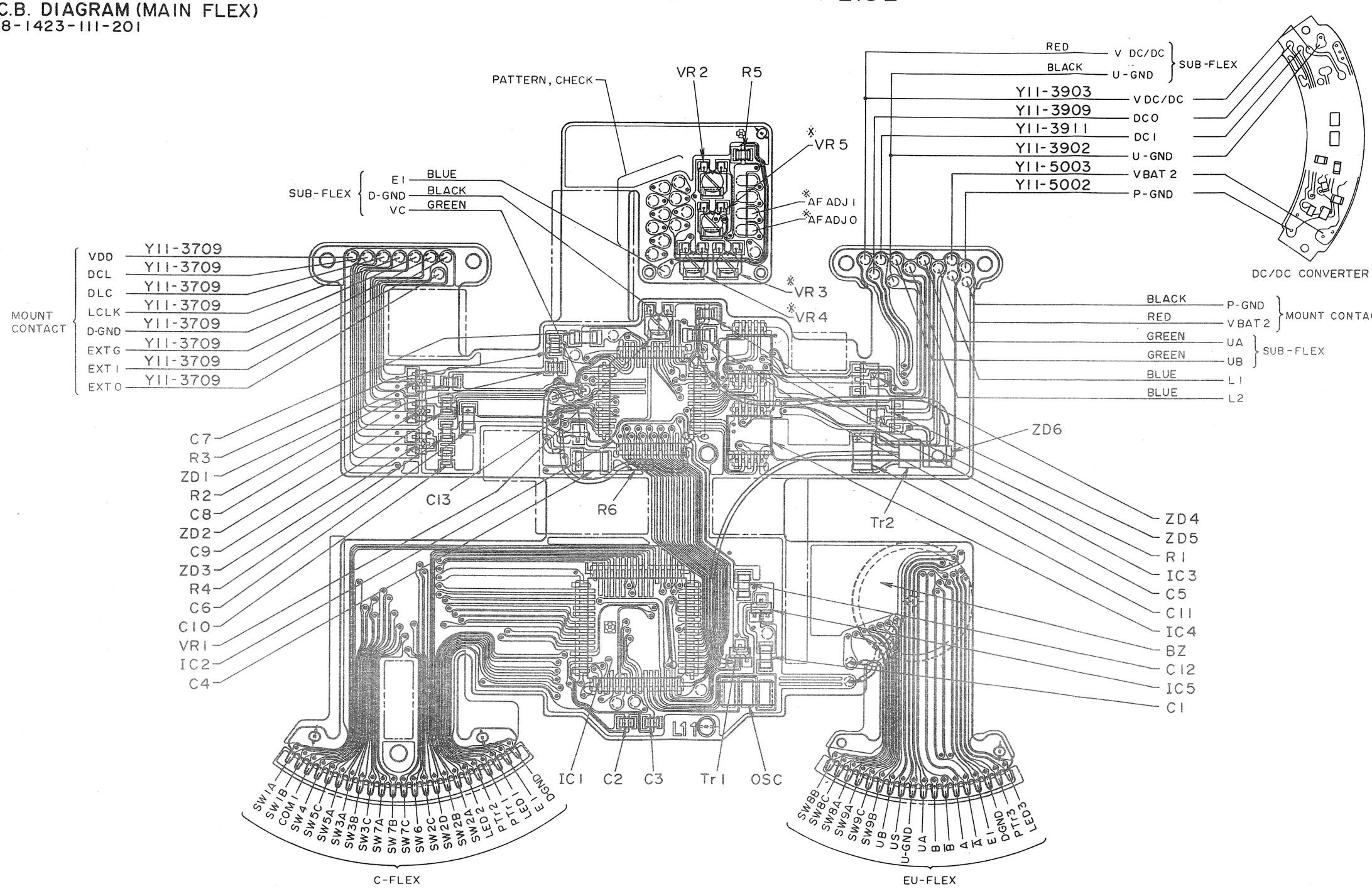
Step 7. Camera SW2 On

	Camera Operations	Lens Operations
1.	When SW1 goes low, IC4 sets [SIC5A] low, [SIC5B] low, and [SIC5A] high enabling IC5 to communicate with the lens.	
2.	IC5 communicates with the lens. lens clock signal (LCLK) and camera data (DLC), and lens clock signal (LCLK) and lens data (DLC) perform serial communications.	IC1 communicates with the camera serially. [Lens clock signal (LCLK) & camera data (DLC) and, lens clock signal (LCLK) & lens data (DLC).]
3.	IC4 sets [VBAT2ON] to low.	
4.	IC8 sets [TOUT] to high.	
5.	IC10 sets [VBAT2] = 6V and sends it to the lens.	
6.		IC1 turnsTr1 on and sends [E1] = 6V to IC2. IC2 instructs the USM to drive the focusing to the "preset" point. IC1 and IC2 communicate serially. [[SIC2A] = low, [SIC2B] = low, clock signal [CLK] and data (D0, D1, and D2)]. Next the signal (PSM) instructs IC2 how much to stop down the EMD.
7.		IC2 drives IC3 and IC4 the number of pulses in the (PSM) signal.
8.		IC3 and IC4 stop down the EMD.

ELECTRIC DIAGRAM

CANON LENS EF 300 mm 1:2.8L

P.C.B. DIAGRAM (MAIN FLEX)
CY8-1423-111-201



02 SEP, 1987

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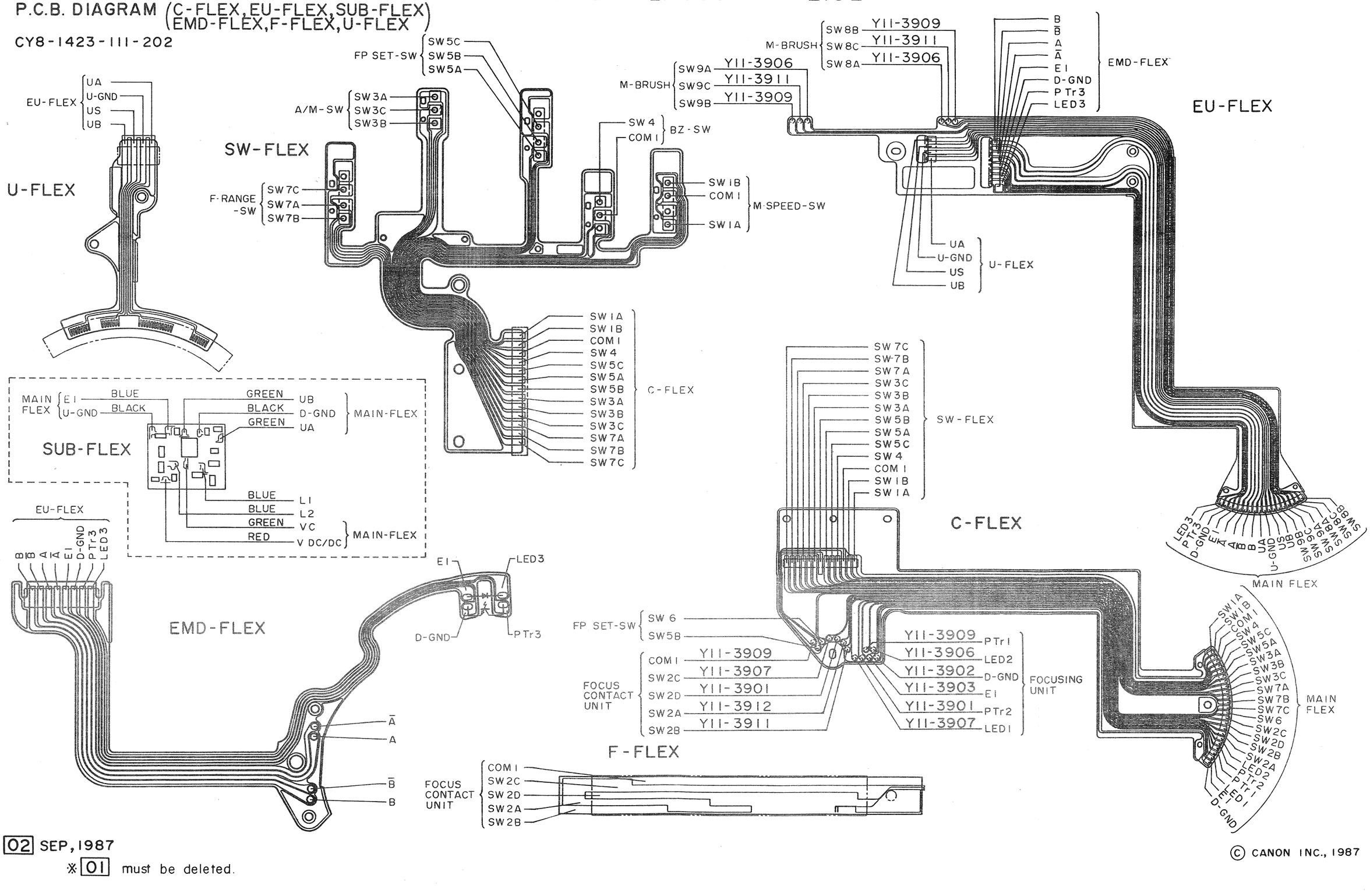
REF. NO. C21-8252

CANON LENS EF 300 mm 1:2.8L

P.C.B. DIAGRAM (C-FLEX, EU-FLEX, SUB-FLEX, EMD-FLEX, F-FLEX, U-FLEX)

CY8-1423-111-202



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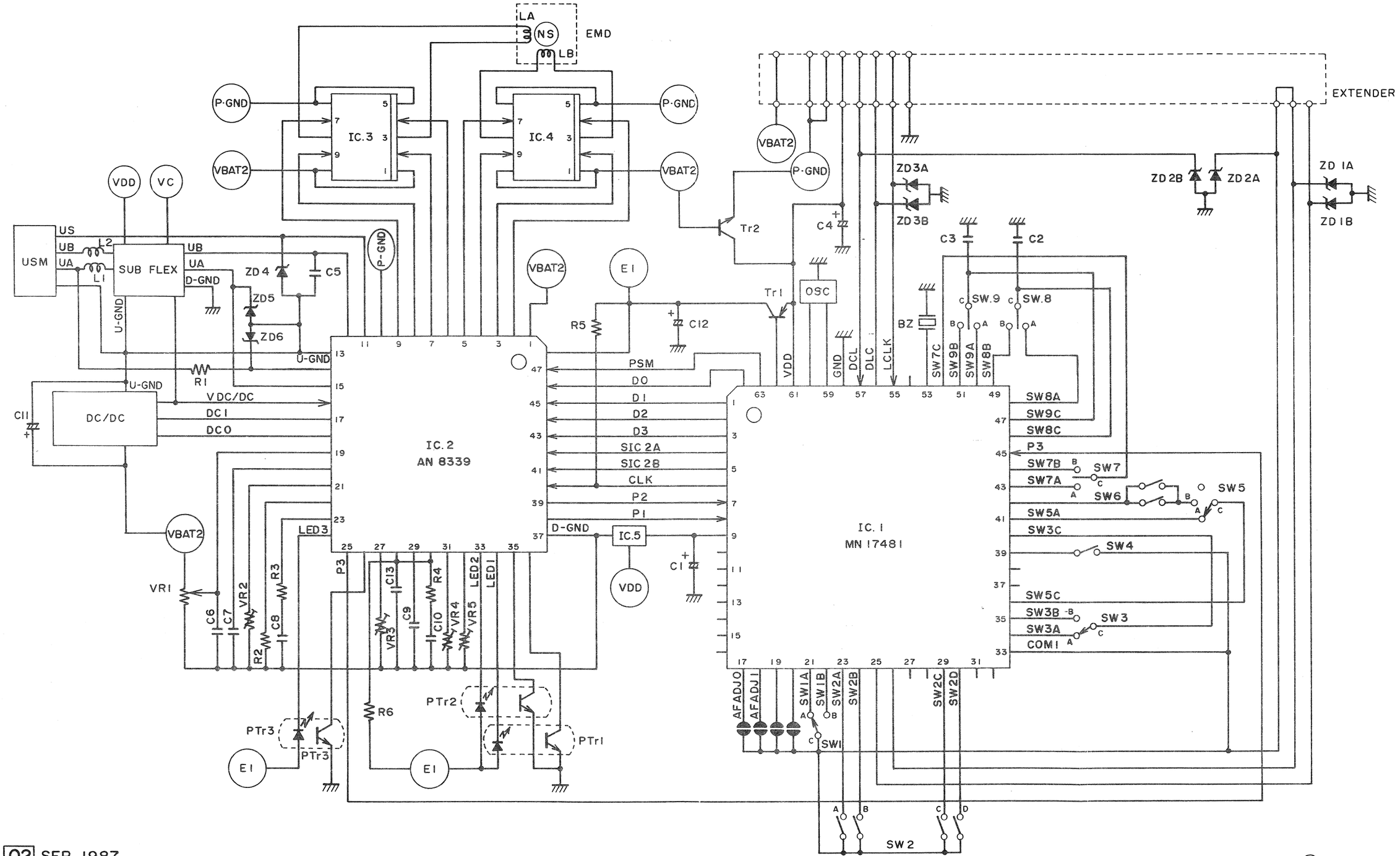
CANON EF LENS (USM TYPE)

SCHEMATIC DIAGRAM
CY8-1623-102-200



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